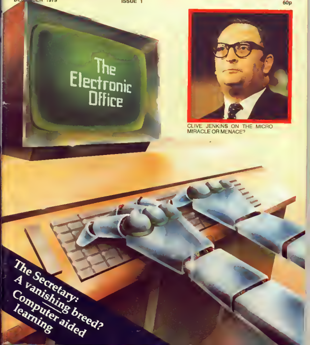
Computer Age

DECEMBER 1979 ISSUE 1 60p



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Computer Age

Front cover: Will the office of the future be manned by robots?

Editorial

Nearly two years ago I became editor of the first magazine on microcomputing to be sold in the newspaper shops of Britain. Many readers will remember me from then, and every reader will realise that Computer Age *is a new magazine with a radically new outlook. This outlook is a direct consequence of the coming of age of the small computer. People who enjoy computing want to graduate to something more substantial: the higher type of application. They are prepared to read informative, creative and stimulating articles, and don't want all their thinking done for them.* Computer Age *is their magazine.*

Chris Evans

Dr Evans spent a year in the preparation and filming of the ATV series The Mighty Micro. *When his book, with the same title, came out, I gladly accepted an invitation to interview him. The interview took place on a fine day, in the garden of his house. Chris Evans put me at ease, spoke fluently, with intelligence and humanity.*

He died a fortnight later, and what was meant to be a straightforward interview turned out to be a tribute to him. It will be published in the next issue of our magazine.

We also intended to review his book The Mighty Micro. *But it has turned from being one of a number of books on micros to being his testament to the public. It is a brilliant testament. Not everyone will like all it says; it does have some Orwellian overtones. But it is full of ideas that are meant to set people having ideas of their own. Those few who live by the ready sneer and disparaging remark, quite divorced from substance, will have none of it; the open-minded and imaginative will generally enjoy themselves. It is a classic of popularisation without trivialisation: a book to keep — and come back to time and again.*

Meyer N Solomon

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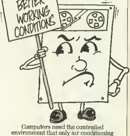

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Computer Age

A sample of articles that will appear in future issues

Professor George Gerhold, of Western Washington University, USA, on Computer Assisted Learning Professor Gerhold is the co-author of PILOT for machines such as the SWTPC 6800 and the TANDY TRS-80

Dr Mike Fairhurst, of The University of Kent, with a series on Artificial Intelligence, developing the introduction by Professor F H George in this issue

Michael Kusmirak of Equinox Computer Systems, writes three articles giving guidelines to accountants on how to advise clients who come to them for help in computerising their businesses

Margaret Rouse How a school teacher took up an opportunity and a challenge, ending up by assuming responsibility for computing in e schools area

Eric Somers on cultural energy and the personal computer

Alistair Forsyth, of Burroughs Machines Limited, on computing requirements for solicitors

Victor Nicola on how to understand the fundamentals of computer arithmetic and logic

Merlene Brown, a highly experienced writer (The Financial Times, The Observer) on the actual experiences of people and businesses

And regular columns by *Martin Banks* of *Computer Weekly* and *Brian Reffin Smith*, Research Fellow in Computing at the Royal College of Art

And . . . David Mitchell, MP, Parliamentary Under Secretary of State at the Department of Industry, writes a revealing account of the Tory Government's deep and abiding interest in the role of Britain in the computer age. Don't miss this article, which appears in the next issue.

How did this copy of Computer Age reach you? Was it passed to you by a colleague all dog eared and torn (the magazine not the colleague) or were you invited to have a quick glimpse before having to hand it back to its owner?

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We confidently believe that Computer Age will quickly become Europe s premier computing magazine We have set the pattern with this first issue Now we intend making it an even better package for people like yourself who have an interest in the computer scene

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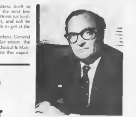
Microelectronics — our future What is the future? Will it lead us all to greater prosperity and freedom? Will it make business more successful more profitable, and encourage them to expand and create even more jobs?

Or will it create great wealth for a highly-skilled and lucky few leaving millions unemployed in a society unprepared for the new age?

Computer Age will address itself to these vital questions over the next few issues It will provide a platform for leading opinion on the subject, and will be conducting its own research to get at the truth

In our first issue Clive Jenkins, General Secretary of the white-collar union the Association of Scientific Technical & Managerial Staff (ASTMS) opens this important debate



TRADE UNIONS AND TECHNOLOGICAL CHANGE

'But trade unions are only too aware of the threat of microelectronics.'

The trade unions are the only organisations in this country taking seriously the problems caused by the rapid development of microelectronics technology Governmental action has been late and is still feeble while academic perception varies greatly We see both sides of the problem because we are already bargaining about it It is clear that microelectronics can bring many benefits not the least of which is the important role it can have in modernising our manufacturing industries and improving our service industries thereby helping to reverse the decline in our economic performance as measured against our international competitors Trade unions know that a future without microelectronics is no future at all

But trade unions are only too aware of the threat of microelectronics since they and their members are on the receiving end The threat is one of wholesale destruction of many jobs and radical changes in many of those that remain Unemployment, deskilling loss of satisfaction greater intensity of work and alienation will be the problems of the 1980s unless we get our policies right to cope with these

There are still some people particularly those with vested interests who cannot see the dual nature of the microelectronics challenge They blandly try to assure us that microelectronics technology will create more jobs than it destroys However all the evidence we have about the impact of microelectronics to date and the intentions of the developers of the technology and the big corporations who will be the first to use it on a large scale points in the direction of a massive decline in the number of jobs available in the future

If we look at the industries which have already been using silicon chips for a number of years we see that the numbers employed have fallen For example, the change over from electro-mechanical telephone exchanges to semi-electronic exchanges has been one of the factors in a 33,000 job loss over five years in the telecommunications industry With the introduction of the fully electronic System X exchange the job loss will be still greater Indeed it is perhaps technically possible to supply all of the Post Office s requirements for System X plus half as much again for export from one large factory alone We will then see the exchange manned by one man and a dog (kept to stop the man touching the equipment)

Computers are large scale users of silicon chips The third generation of computers was made possible by integrated circuits and the effects of this change can be seen in a large scale drop in employment from 53,000 in 1971 to 43 000 in 1977 As the scale of integration continues to increase, these trends can only continue

Nor is this simply a British problem We have lost jobs in our TV industry through a failure to apply new technology quickly enough However in Japan, our major competitor in the TV field the introduction of integrated circuits and the automated insertion of components into boards has resulted in up to 50% job loss in their major TV manufacturing companies The seat warmer and window watcher are common Japanese terms and will become commoner still when the effects are felt of the billions of dollars allocated to this field by the Japanese Government

We can also point to the major effort being put into developing unmanned machining centres by Germany Japan USA and Bulgaria, not to mention plans being put forward in the UK for automated small batch production The Post Office is intending that under System X most of its exchanges will operate unmanned

The Problems

The first problem is the vast area of office work which is on the verge of transformation Where trials have been conducted with word processors for example, productivity has rocketed and jobs have disappeared Many large companies are planning for integrated office information systems in the 1980s which will combine word processing, electronic mail and automatic filing and retrieval

It would be an act of insanity to ignore these problems particularly since they will appear at a time when more people will be looking for work than ever before (an extra two million by the mid 1980s?) Against a background of worldwide high recession the trade unions are the only bodies trying to face up to these problems that is why the TUC has sent a major economic delegation to discuss the issues with American AFL-CIO

The last Labour Government had the virtue of starting to recognise the importance of microelectronics for reversing the decline in our industrial and economic performance It is appalling to realise that, according to a Department of Industry survey 50% of our manufacturing industry had not heard of silicon chips Another 45% knew what they were, but were not considering applying them in their own fields. Only 5% of industry was actively trying to develop applications. This is despite the fact that the Department of Industry had identified at least one hundred fields where silicon chips had readily identifiable applications.

The then Labour Government instituted a number of programmes to help break down this 'head in the sand' attitude. They set up the Microelectronics Industry Support Programme (MISP) to make development money available for applications of microelectronics. They started a Microelectronics Awareness Programme (MAP) to promote knowledge of microelectronics among 50 000 key people from all sides of industry and commerce and which helped fund the TUC fact-finding mission to the US. They supported the NEB in its efforts to set up INMOS, INSAC and NEXOS. Unfortunately, the Labour Government was curiously silent on the social impact of the new technology. I write this with tongue in cheek: *the dangers were edited out for political reasons in advance of a General Election.*

It is difficult to find anything positive in the policies of the new Tory Government in relation to microelectronics. Their commitment to the free play of market forces makes them very antipathetic to state support for the microelectronics industry. They have cut the cash allocations to MISP & MAP and are just barely tolerating the role of the NEB in backing INMOS, INSAC and NEXOS. Their idea is that if these ventures succeed and make profits they can then be sold off to private industry. This is a strange way to attempt to distribute the benefits of new technology fairly. It is based on the principle 'you do the work, we get the profits'.

The rapid adoption of new technology is only possible on the basis of consensus and that consensus will not be achievable unless social policies are adopted to minimize the dislocations that are bound to arise. The Tories are following policies which will not only make the dislocations worse, but will also make it harder to achieve the consensus needed to overcome them.

High Burden

Their general attack on public spending will add to the already too high burden of unemployment. The reduced allocations for the Manpower Services Commission will make it more difficult, not to say impossible, to set up retraining programmes and job creation programmes on the scale which is needed. The cuts in education will not only affect retraining, but will also mean that adult education and life-long education can play no part in preparing people for the changes in their working lives and their lives generally. It will also make it more difficult to impart to young people the broad based approach to life which will be their best asset for the future. At the same time University places will be cut when all other industrialised states are expanding higher education.

At a time when unemployment is rising the Tories are considering reducing the earnings related benefits which take unemployment pay somewhat above the level of pittance. They are also considering raising the retirement age for women to 65, instead of reducing the retirement age for men to 60. These propositions are historically out-of-joint.

At the moment it is the trade unions which are carrying the burden of progressive thinking on microelectronics. At the 1979 TUC Congress a major resolution was passed. It began by accepting "the need for Britain to be in the vanguard of technological change", and it recognised "the unique and unparalleled opportunity provided by advances in the field of microelectronic technology for Britain to improve its economic performance and also its competitiveness in world markets while improving living standards, affording more leisure to employees, eliminating dreary work and improving communications between people and nations". Congress expressed its concern about the threat of increased unemployment and said:

> Particular attention will have to be given to retraining and equipping workers for employment opportunities in newly created jobs in the public, private and leisure services in which technology is less likely to replace labour. Other transitional problems will include the need to provide adequate compensation for displaced workers and the negotiation of formal planning and technology agreements giving unions the right of access to management information systems.

'It is the trade unions which are carrying the burden of progressive thinking on microelectronics'

A priority is to ensure that the benefits obtained by the application of the new technology are used in the interests of the community as a whole. The resolution continued:

> As part of an overall employment strategy the opportunities presented by microelectronics must be used, not only to change working patterns in offices, shops, stores and industry generally, but also to improve the quality of life by the introduction of a shorter working week without loss of pay, longer annual holidays, less arduous conditions of work and provision of early retirement or an adequate pension.

This is the most comprehensive programme for dealing with the problems of the new technology yet to emerge. The ideas and reasons behind this programme have been set out by ASTMS in its discussion document 'Technological Change and Collective Bargaining' and in the book *The Collapse of Work* (*jointly authored by Barry Sherman and Clive Jenkins. Published by Eyre Methuen at £3.50*). Other unions have also issued studies on the impact of technological change and the TUC itself issued a detailed report 'Employment and Technology' to the 1979 Congress.

Welcoming progress

The trade unions also moved a motion at the 1979 Labour Party Conference which welcomed progress in microelectronics. It recognised that "the progress of technological change must be subject to the involvement and consent of the workers concerned", and said that "this will require the full involvement of trade unions in the planning of changes that may so dramatically affect their working lives and living conditions". It went on to call upon the Government to pursue full employment and encourage job creation and retraining.

The trade unions have also recognised that the problems posed by microelectronics are international in nature. In October the TUC delegation of which I was a member visited the USA to hold discussions with its counterpart, the AFL CIO, as well as other organisations and to visit California and Arizona to study the applications of the technology and the problems encountered there. Phoenix, Arizona is an industrial growth area based in large part on modern technology, while California, of course, is the home of Silicon Valley where most of the chip manufacturing companies have their headquarters.

In July when I was a Foreign Scholar at the Woodrow Wilson International Centre for Scholars in Washington, I looked at some of the new frontiers including the lasers and Puma robots at the GM High Technology Centre in Detroit — and found our future is already their yesterday.

ASTMS itself has sent representatives to the annual conference on Electronics and New Technology organised in the USA by the International Association of Machinists and Aerospace Workers and will also be represented at an important forthcoming conference organised by the Communications Workers of America in Dearborn with 800 delegates present.

In 1978 a BBC programme on microelectronics concluded that in relation to the problems posed the silence was deafening. Since then there has been a lot of noise about microelectronics, but who, apart from the trade unions, is really saying anything?

Why? Fear?

NEXT ISSUE **David Mitchell, M.P., Parliamentary Under Secretary of State, Department of Industry, writes on** *Closing the Microelectronics Gap*. **Meanwhile, write in with** *your* **experiences and opinions.**

NOTE TO READERS **INMOS, INSAC and NEXOS** are government supported, and deal respectively with memory and hardware, software and office systems. According to the NEB, they are supposed to be names and not abbreviations.

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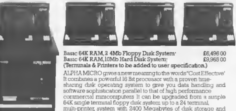

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David Levy

ARE GAME PLAYING PROGRAMS INTELLIGENT?

Whether we like it or not, intelligent machines are here to stay.

That is the thesis of this whole article, and since there can be no doubt that *game playing* programs are here to stay, I need only prove that game playing programs are intelligent in order to justify my opening statement.

Unfortunately, such a proof requires not only logical argument on my part, but also the sympathy of the reader, since there are still many scientists who support the view that a machine cannot be intelligent even though it performs a task traditionally associated with intelligent human beings. This state of affairs will eventually lead me to ask, once again, the question "What is intelligence?" and I hope that even though I do not suggest an all embracing definition, I will at least be able to show what I understand by intelligence, simply by giving a few examples of "intelligent" and "unintelligent" behaviour.

Programs already exist that can perform medical diagnosis

Let us begin by considering the emotion behind the argument that computer programs cannot be intelligent.

It is commonly held view, and who am I to disagree, that chess Masters are people of exceptional intelligence. Goethe even went so far as to say that "The game of chess is the touchstone of the intellect" and he was no mug. The same view is held, albeit on a slightly lower plane, of those who are outstanding bridge players, those who can solve *The Times* crossword in twenty minutes and those who display a similar talent for any other complex intellectual task. Yet very few of those who elevate chess Masters to the summit of some intellectual pedestal would agree that the world's strongest chess program is also highly intelligent, and I contend that this attitude is grossly unfair to the poor machine (or rather the machine/program combination). After all, if chess is a game which requires intelligence to play it well, then surely a computer program which is a strong chess player must also be intelligent. If nothing else, this double standard shows that when we humans speak of intelligence we do so as though it were ours by prerogative — an emotional viewpoint lacking in objectivity.

One difference between human thought processes and those of a computer program is very clear. When a human chess master/bridge master plays a game he sometimes does so in a completely different way to the way that the best machines perform the same task. The end result is the same, or nearly the same — a good move on the chess board or a neat coup in a hand of bridge — but the manner in which the decision was reached is often entirely different.

Allow me to illustrate this with three examples. In a game of chess a human master calculates his move on the basis of his evaluation of perhaps fifty or a hundred chess positions. He looks at the moves he knows, from years of experience, to be the only plausible moves in the position, then he looks at the plausible replies to these moves, and so on, but because his criteria for move plausibility are very strict, the total number of positions examined is small.

What the human master does do in very great detail is examine each of these 50-100 positions to determine whether they are positions that will be good for him, or good for his opponent, or roughly equal. To do this he considers various subtle nuances that are beyond the understanding of even the very best computer programs.

For example, a human chess player might know that a particular type of pawn formation will be detrimental thirty moves hence because (say) his opponent's king will be able to infiltrate his pawn chain by means of a sacrifice. It is the chess master's vast reservoir of such nuances that makes him a master, yet strong chess programs occasionally win or draw a game against a Master or Grandmaster without employing anything more subtle than a ten ton rock. How is this possible?

Aspects

> 'If nothing else, this double standard shows that when we humans speak of intelligence we do so as though it were ours by prerogative — an emotional viewpoint lacking in objectivity.'

The machine plays chess by examining all of its possible moves, all of its opponent's replies to these replies, and so on. Because it does not have the subtle understanding of a human it cannot prune away vast sections of this enormous tree of possibilities, it must look at the whole tree, and since the typical middle game position in chess offers some 36 or 37 moves, even a relatively shallow look ahead tree contains millions of positions, and requires minutes of computer time. When looking at these millions of positions the program cannot employ the same degree of subtlety in its evaluation as the human master does when examining his 50-100 positions. Instead, the program uses a far more primitive evaluation mechanism, but uses it much more often.

Thus we can see that in writing a computer program to play chess, the programmers do not attempt to simulate the thought processes of human chess masters, but look for ways of arriving at the same solution via purely artificial means. The manner in which programs think about chess is anything but intelligent — it is merely a brute force search of an enormous tree of possibilities, but the moves that come out at the other end are intelligent moves in a complex intellectual game, so are the programs intelligent or are they not?

Now let us consider bridge, also intellectually difficult to master yet completely different in nature from chess because of the unknown factors — which players hold which cards? Because of this hidden aspect of the game it is necessary for a bridge program to perform some rather clever deductions if it is to play well.

In a typical situation a player might need to guess where a particular card is situated. He can see two of the hands, his own and the dummy's, but the other two are hidden from him and the best play requires him to make a logical guess at which of the other two players holds the vital card. All sorts of factors can help him make this guesstimate. If a player bid spades he will probably be more likely to hold the missing card if it is a spade. If the player passed throughout the bidding, indicating that he was weak, and subsequently played two kings from his hand, it is a fair bet that he does not have any more high cards, otherwise he would have bid. These are relatively simple guidelines that even weak human bridge players can follow, and for a computer program it is not at all difficult to make the same deductions.

But one has merely to read an expert's analysis of a bridge hand in a newspaper column to realise that although a very deep, logical analysis is possible, some decisions at the bridge table are based on an indefinable sixth sense, which distinguishes bridge champions from lesser players. I would not deny that a sixth sense is part of Grandmaster chess, but in bridge I feel that intuition plays a far greater part, simply because of the nature of the game. And when programs exist that play expert bridge, will the sceptics complain that they are not intelligent programs merely because their decisions are based entirely on probability theory rather then intuition?

Another game which interests me is poker. Poker has the same unknown element of bridge, but it also has something more — the notion of bluffing. Being able to bluff at the right time is a great asset to a poker player and those who are really good at the game, good enough to make a substantial living, can gauge when a bluff is likely to succeed and when it is more likely to fail. This is done not only on the basis of which cards are showing (if the game is stud poker) but also on an understanding of the style of a particular opponent and even his mannerisms, if he displays any at the poker table.

Joe's ears

One might argue that a computer program would not make a good bluffer, but why should this be so? It is true that the program will not be able to notice the fact

Some decisions based on indefinable sixth sense that Joe's ears always go red when he is bluffing, or that Fred scratches his nose when he has a bad hand, but in contrast it will have the advantage that it will exhibit absolutely no emotion when bluffing, and since it is psychologically difficult for most humans to play intelligent games against a computer program, there is a compensating factor — the humans will believe that the program knows when to bluff and this will cost them dear as they allow emotion to override logic.

Since the best poker players are undoubtedly highly intelligent people, can we argue that a good poker playing program is a highly intelligent program, even though it may be written in a way that does nothing more than imitate the thought processes of a good human player?

I have chosen these three examples because I feel that they represent a cross section of the possible approaches that computer programmers can take to intelligent games.

In chess the programming strategy is to make up for lack of subtlety by doing something rather unintelligent (i.e. using a primitive evaluation mechanism) but doing it very often, so that the end result is satisfactory.

In bridge it is quite possible for a good program to make most of the same deductive decisions that a good player can make and the difference here between good play and outstanding play will be that sixth sense, which so far remains an impossible programming task.

Finally we have poker, in which there is absolutely no reason why a really strong program cannot be written to imitate the thought processes of the intelligent human player. In each case the end result is play which would be classed as intelligent were it to emanate from a human being but, because it comes from a computer program, will often be scorned as good but unintelligent. In my opinion this is being very unfair to the program (and the programmer), and I would advocate the application of identical standards to man and machine when discussing intelligence within any sphere, be it game playing or general problem solving.

If a member of the newly discovered Willy-Nilly tribe of South American Indians were to be found to play chess as well as Bobby Fischer, he would doubtless be hailed as super intelligent, even though he might have found a simple numerical method of playing the game perfectly. Yet if a programmer discovered the same method, and programmed his chess algorithm accordingly, would his work receive the same acclaim? I doubt it.

What, then, is intelligence, and how do we recognise it in a game playing (or other) computer program? This is becoming an increasingly difficult question to answer. Is it a pre-condition for an intelligent program that the "thought processes" of the program should be similar or identical to those of a human expert in the same field? The classic answer to this question was supplied by the English mathematician Alan Turing, who devised the benchmark test for all Artificial Intelligence work. When applied to the task of game playing programming (say chess for example) the Turing test may be expressed thus:

If a chess master (i.e. an intelligent human) is playing chess via a teletype against two different opponents, one of whom is also a strong human chess player and the other a computer program of similar strength, then if he cannot distinguish between the two and tell which is the human opponent and which the program, the program can be considered to be intelligent.

Personally I accept this application of the Turing test, and I contend that the best chess programs can already pass this test. Therefore they should be considered intelligent. I should now like to leave the reader with the following question. Of the following six decisions, three stem from computer programs and three from groups of intelligent humans. It will be quite obvious to the reader that the humans' decisions are far from intelligent, and equally obvious that the computer decisions, were they made by human beings, would be considered the decisions of intelligent people. What conclusions should we draw from this?

Decisions by computer

- In the last round of a chess tournament in Washington, in December 1978, a computer program called *Belle* found a brilliant win that required it to sacrifice its rook and queen.
- A theorem proving program in the USA once found a new proof of Pythagoras' theorem.
- Programs already exist that can perform medical diagnosis, in certain branches of medicine, faster, more accurately and less expensively than doctors can.

Decisions by humans

Recently, the workers at the Reveille newspaper went on strike. They were complaining that one of their ex colleagues, a 78-year-old man who for more than two years had been paid for a job that had become non-existent, thanks to modern technology, was not going to be replaced. The strike lasted for three weeks at the end of which time the newspaper was closed down by its owners, and the intelligent men who had come out on strike were all without jobs.

Residents of Oxford will know that first class mail, posted in Oxford and addressed to Oxford, takes longer to reach its destination than second class mail posted in Oxford and addressed to Oxford. This is because all first class mail posted in Oxford, even that addressed to Oxford, is sent via Reading. The GPO employ thousands of intelligent people to make such decisions.

In 1972 the Science Research Council report on Artificial Intelligence, written by Sir James Lighthill FRS, condemned much of the AI research being conducted in Britain at that time. In particular, the area of robotics was singled out. As a direct result of this report the SRC stopped funding some of the most advanced AI projects in Britain. Those responsible for this decision, all intelligent (no doubt) must now be wondering why Britain lags so far behind the USA and Japan (amongst others) in AI and robotics achievements.

My conclusion is rather obvious, if cynical. Not only are intelligent machines here to stay, they will eventually be making many of the day to day decisions in all walks of life. Personally I feel rather ambivalent about the prospect. On the one hand life is warmer with people than it is with computers. On the other hand, I am sure that anyone living in Oxford will be glad when the GPO is controlled by a giant computer.

GPO employ thousands of intelligent people to make such decisions

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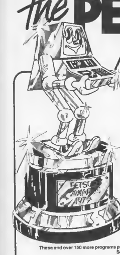

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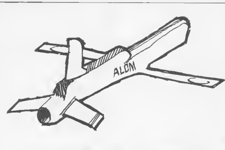


ARTIFICIAL INTELLIGENCE AND THE LAYMAN

When first heard, the words Artificial Intelligence conjure up expressions of surprise and disbelief on many people's faces. The word intelligence poses a problem, since it is often confused with knowledge. Intelligence is not easy to define precisely but it undoubtedly involves (at least) making the best use of whatever information you have; in practice, we can usually distinguish a highly intelligent man from a stupid man without being able to spell out the difference in detail. Our aim is to produce an artificial (ie made in the laboratory) system — 'man' if you like — though some workers in the field of Artificial Intelligence believe it is only concerned with making a computer intelligent. I believe it involves more than this.

Now, our task is a long and difficult one, and some may say impossible. First of all we must ask what properties an artefact (let me use this word, if only for brevity's sake, for our artificial man) must have.

Unlike a machine in the usual sense — a motor car, or an aircraft — we want a machine that does not need an independent human intelligence to run it; it must supply its own, which is built into it. This means it must be flexible, adaptive and able to learn about itself and its environment, at the very least.

'Now, our task is a long and difficult one, and some may say impossible.'

A human being senses his external environment by use of his senses — eyes, ears, etc, and his internal environment — the awareness of hunger, thirst, etc — by awareness of internal (biological) changes of state. The information collected by the senses is put together to provide a 'picture' of the environment at any particular moment. This allows us to recognise people and places, threats to our safety and the general state of affairs at any moment, and so on. This process we call *perception*. Our first search then is for an artefact that perceives, and we find a whole host of models available to us — some in hardware and very much special purpose, some mathematical and some (most) in the form of computer programs.

This is the moment to make two important points. The first is that we can copy human behaviour, as far as we can tell, in every way and, even though it will be a long time before such artefacts can be made of flesh-and-blood, they can, it is to be hoped, be made by metallic and chemical means to achieve the *same* ends by the *same* means. And secondly, other workers in the field of Artificial Intelligence are only concerned with the same *ends* and not the means. This latter group comes near to automation in practice and can already go a long way to providing the latest jet aircraft with almost enough intelligence to dispense with a human pilot and enabling factories to be computer controlled.

A word now about the computer. The only reason the computer is so popular in the field of Artificial Intelligence (as indeed with many other sciences) is that it is the *only* huge and fast machine available which, if properly programmed, can copy (simulate) any system whatever. It may be awkward to do so sometimes since the computer was designed primarily for mathematical work but it *can* be made to copy human behaviour and, if it gets all the principles right then it can improve on it. This is so simply because it is not limited by the biological constraint of the size of the human head. In fact our artefact can have a brain as large as we please (or need) and its limbs necessary to effect actions and change states of affairs, can be remotely controlled so a brain in London can have limbs as far away as Sydney. The nearest thing to this in human behaviour is the use of language, where a man in London telephones a man in Sydney and tells him to do something or other.

Before we leave the means by which we communicate with our outside and inside world (perception) let us just say that some of the methods that have been suggested are the classification (usually partial and limited) of events and the (pattern) recognition that asks whether any event is like another event which we have already recognised: two football matches have a lot in common, as well, of course, as their differences but we can recognise them both as football matches. We also have template models of perception where we compare shapes like triangles and circles with recorded and stored replicas even if it does involve expansion, dilation or rotation of the perceived image to acquire the correct match. It is possible that some mixture of these two methods of pattern recognition are what happens in the human being, and certainly such models can be built to successfully perform perception. The whole process of perception is, of course, wholly linked up in turn with conception, indeed is a part of it.

Conception is also an aspect of pattern recognition. It is made up of many different activities (all doubtless deeply integrated) such as learning, problem solving, decision taking, planning, thinking, language and logic at the very least.

It seems that each of our senses (or some of our senses at any time) pick up information independently and partly interpret it, and then the partial interpretations are stored as a central overall picture. This when it gets that far, is stored in long term memory (LTM), although *en route* it is, at the partial level, in a temporary store, or short term memory (STM).

Using information

We use this stored information immediately or in the long term, whenever the opportunity, or circumstances, or needs arise. In other words, having learned how to play golf, I may never actually play the game itself, but if the occasion arises I am in a position to use my knowledge. If circumstances, such as the rules of golf change, then my own methods and equipment will change accordingly. The idea is that we can adapt to changing circumstances, but even our change of ideas or our actions are *purposive*: they are motivated by our needs.

What makes us act or think differently is to satisfy basic motives such as the need to eat when hungry. Then our secondary motives are all the things that become *associated* with our satisfaction, and that occurs both positively and negatively: pain and the associated events lead to those associated events being disliked.

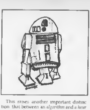
Problem solving differs from learning only in that it has a quite specific goal or set of goals, learning in general can be quite incidental, so we learn a lot about our surroundings quite incidentally — when looking for the grocer's shop we learn where the chemist's shop is. But problem solving, although it may involve incidental learning, is concerned primarily with finding the solution to a particular problem.

> *'The process of imagination must also be involved, otherwise there can be no way a machine can foresee the consequences of its actions.'*

From the view point of Artificial Intelligence, there are, as in the case of perception, a whole range of learning and problem solving models. The simplest example is the maze running machine. This learns by experience, to turn left, turn right, go straight on, etc, until the goal is reached. If "food" is present and the machine is "hungry", then the problem is solved and learning has taken place. Kenneth Craik at Cambridge built such a machine back in World War II. When it was running out of power it searched for a power point and when this was found plugged itself in and re-charged its batteries.

Such sequential "games" can be learned, by repeating success and avoiding failure (or at least not repeating it) until games like halma, draughts and even chess can be played by a "machine", usually in the form of a computer program.

Noughts-and-crosses brings out the basic principle. We number the nine squares 1 to 9, and then the machine learns which are winning combinations (diagonals, rows and columns all filled by an 0 or an X), records in memory the successful moves, and repeats them. Memory (LTM and STM) is clearly vital to intelligent behaviour.



This raises another important distinction, that between an *algorithm* and a *heuristic*. An algorithm is a completely automatic procedure and this can be found for games like maze-running and noughts-and-crosses, so that the correct goal can always be reached first time. In the case of noughts and crosses, provided both players know the algorithm, every game will end in a draw.

A heuristic is a rough rule of thumb which is employed where an algorithm is either unknown or uneconomic to use. In playing chess, and many computer programs exist for this, the methods are heuristic. We make what looks like the best move but cannot be sure of the consequences or what move our opponent will make.

One point *must* be made absolutely clear: you cannot program the computer to play chess according to fixed rules laid down in advance — this would be complete nonsense. Our chess-playing machine will be programmed to learn to adapt according to circumstances, and it can do this just as a human does, by playing games, even games against itself, and by "reading" books on chess. Artefacts have the ability to learn for themselves through either experience or language.

The very use of the words "reading" and "language" is a reminder that the artefact we have in mind must be able to use language. A computer has always had to use a computer language of some sort, but the most important recent development has been the ability to use ordinary English, or something very near to it. There are in existence a number of such languages such as SIR, SYNTHEX, BASEBALL and LISP among many others. Furthermore, we have now built speech synthesisers and speech recognition systems which go beyond written English and its understanding by a computer, to the spoken word and its understanding of the spoken word: both can be done by machine methods.

Thinking

Thinking depends on reasoning and logic at the very least and, once again, we can point to computer programs that are capable of drawing logical inferences. This capacity can even be built into the languages referred to above.

Overview

Thinking itself is a contemplative process involving both learning and language. It involves the symbolic representation of events, such as the games we have mentioned, and can refer to any other set of circumstances whether strictly symbolic or pictorial. This too can be carried out by a computer program and is exemplified by the consideration given to, for example, a chess move. What is needed is a consideration of the range of possible acts and then the full range of possible outcomes of each act.

We need at this point to say something about consciousness and imagination. Any machine which can foresee the possible consequence of its acts and can use language which involves words like 'I', 'me', 'myself' must have the self awareness we call self-consciousness. The process of imagination must also be involved, otherwise there can be no way the machine can foresee the consequences of its actions.

What then do we still need to do to cover or copy *all* the characteristics of rational man? The answer is *nothing*, or practically nothing. There is still room for more work on all the above various characteristics, and there is reason to believe the conative (emotional) activities can (and must) all be included. What has not yet been achieved is the total integration of all these characteristics into one single integrated system. This is a daunting task that will take years yet to achieve.

Even matters of machine reproduction can be approximated to, this is obvious when we remember that machines are already used to manufacture machines. This same process could apply to artefacts, and a mathematical theory of such machine reproduction was developed nearly thirty years ago by the famous American mathematician John von Neumann. The possibility of a machine society is a genuine reality, since once we make an integrated artefact of sufficient intelligence, and this is only a matter of time, then one of the first things it will learn to do is to stop us cutting off its power supply, just as a human being learns, in general, not to be killed. In other words the old belief that we can 'always pull out the plug' is of no use as protection. Furthermore the Intelligent Machine can reproduce itself as often as it wishes.

So the answer to the layman's question "What is Artificial Intelligence?" is the gradual realisation that, thanks ironically to human genius, we have learned (or are in the process of learning) how to re-create ourselves other than by ordinary biological means. We will first build such systems directly, but ultimately, if we get that far, we will build the seed (comparable to the spermatozoa) and let it grow into a superman or super artefact.

Machine Intelligence (the other name for AI) is proceeding piecemeal to build better machine perception, better machine learning and thinking, better machine

I tell you the one on the left is the robot

language and logic. There are groups with similar interests who are trying to clarify the conceptual and philosophical problems involved.

But all paths lead in the same direction, the construction of the artefact. Again we should remind the reader that this means the ability to recreate human abilities in full in the laboratory.

If there were still some objection that artistic creativity would be missing from such an artefact, the answer is that such artistic activity would be automatically built around the combination of our senses and our emotions, the cognitive and the conative in a social situation. We must hence remind ourselves that we must, to copy man, form a machine society, and it is from all these things put together that the artistic activity arises. We have no space in this short article to provide a detailed examination of all these points, although I have written a more detailed account in a recent book entitled *Man the Machine*.

Creating an artefact

It was the eminent mathematician Alan Turing who posed the conditions for the creation of an artefact. It was based on the Interrogation Game, in which two people had a conversation (by way of a typewriter and without seeing each other) and an observer was to try to detect which was the man and which the woman — lies and bluffs, of course, were allowed and even vital to the concealment of the truth. Turing replaced one of the human beings by a machine and then said, 'If you cannot tell which is the human being and which the machine, then you have to accord the machine human intelligence.' Once having got that far it is clear that the machine can exceed the human being, since, as we have said, it is not limited by size as the human being is.

Turing added that if you detected some deficiency in the machine, then from your explanation of the deficiency he could build in the missing property: this is perhaps not to be taken too seriously, as you can detect something is missing without necessarily being able to describe what it is.

There is one vital misconception that occurs in the context of these discussions. It is the popular belief that machines (eg computers) only do what you tell them to do. While this is true for 99% of computer usage, it is not *necessarily* true. It is possible — and this is the whole point of our argument — to program a computer to be adaptive (capable of change and learning), flexible and interactive (capable of thinking and conversing) and capable of reasoning. It may still be true that such a machine can still only do what it is made to do in the same sense as human beings can only do what they are made to do, they cannot run a mile in two minutes, or solve certain problems.

The truth is that we are moving towards a blueprint of a human being, this is what all biology and all medical science has always tried to do, and the research is gradually but inexorably moving towards that end.

None of this would be possible on the present time scale without the only huge universal machine — the digital computer. It is universal in the sense that it is incomplete without the computer program. What we have discovered is how to write programs that make the computer behave like a human being, and then finally, such, by now, special-purpose computers can gain their independence with their own increasing intelligence — since they not only know things but know how to learn for themselves. This is the science of Artificial Intelligence in all its complicated ramifications.

One last comment and that is that I see great dangers to human beings in the *uncontrolled* development of AI, so I believe we ought to consider how exactly we should (if we can) ensure that a machine society is not set up which we cannot control — I am not sure, though, how that is best done, perhaps we are safe for a few years yet.

Professor [illegible] of Brunel University has written [illegible]

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COMPUTER AGE MEETS JOHN A MARSHALL

John Marshall is M D of Nascom Microcomputers Limited

What can a microprocessor do and how will its effect be felt?
Well it has the raw computing power of probably the most advanced computers that were available in this country say 15 years ago and in volume you can buy that part for between 5 to 15 Dollars a piece. You do not need an enormous amount of supporting cast as it were. As you can see with Nascom 1/2 we are talking of 30 40 50 chips and you have yourself a very powerful single board computer. That is in as few words as possible what a microprocessor is and what it can do and what it means to microcomputing.

What does it mean to you and me?
To me I think the most important thing is the fact that it is the precursor of the Second Industrial Revolution. People who with Trade Union leanings stand up and say it's going to put millions of people out of work may well be correct. They may not be wrong in trying to draw attention to the potential damage but by the same token you can't adopt the King Canute attitude of trying to stop the inevitable.

Somebody is going to do it so it's a matter of deciding whether you want to be in the front or the back. Like many revolutions previously for example the steam engine mankind will come to terms with it one way or another.

But is it not also going to open up new industries for this country?
Only if we're prepared to grasp the thorny nettle. Chucking what they say is £50 Million into Inmos but what inevitably will be £500 or £5 000 Million is not going to do us a great deal of good. It makes more sense to invest £50 Million into a number of smallish companies who are building products where the microprocessors for the sake of argument cost less than ten dollars. For example the cost of the CPU on a Nascom 1 represents about 3% of the total resale price. So you've got 30 times value added.

But at the moment there's more than one chip on a board
You've got one microprocessor and umpteen other support chips.

But are you saying we shouldn't produce any of the chips?
Well I think we're trying to compete with some very well-established opposition and the amount of money and expertise you are going to have to put into getting a satisfactory return is going to be much larger than if you go for value added as the first approach. In other words you say right, the Americans the Japanese, will build the chips for us now what product can we build with these chips where we can take in, say £50 worth of imported devices chuck in another £50 worth of domestic meterials and throw out an item for £200? The value to the country is far far greater than in slicking God knows how much money into building chips.

But you are already experiencing supply problems with chips. Do you think we as a country can afford to rely on overseas sources?
Well I think that the commercial pressures on any semi-conductor company which virtually by nature is an international organisation regardless of its home base are going to overcome most shall we say desired lines of supply. For instance if you had a home based company and it could get $5 in the UK for a part and $20 overseas I'm sure it would find ways of rationalising its production towards shipping $20 parts.

The main problems at the moment are in 74 LS. Some of the wafers for those are being made in Scotland by National. All of National 74 LS production wafers to my knowledge are being made in Scotland. The parts are then shipped to the Far East for assembly and then back in again. You can't think in terms of a manufacturer as totally indigenous. The minute you go overseas then you go into the international market place.

So are you saying that success for the UK is in applying these chips into hardware?
Yes. And software production. Software is an area where we have always been very strong as a country. So in 10 years time, of the average microcomputer as far as overall costs are concerned 20% will be hardware 50% will be software and 30% will be miscellaneous. So the value added will be far more worthwhile than just the chip by itself.

So how do you see this country in the big league in about 5 years time?
Well the manufacturing of currently non-existent chips. Or perhaps embarking on some joint venture such as GEC — Fairchild which I think is a sensible way of going about it. Going in cold with Inmos I think is taking too much of a risk. An unnecessary risk considering it's all public money. I don't think that's on. I see more collaborative ventures both with European US and perhaps Japanese manufacturers. So where I want to see the move forward is in applications in the production of hardware that is microprocessor based.

What support are you getting from the Government?
Well we're told that we could claim upto 50% of development costs on new and innovative products from the NRDC. But that's not as a grant it is on a loan basis of a recovery on estimated sales. So it's not just a straight forward handout.

Have you tried to get a handout and if not why not?
Well there are small handouts but compared with the overall cost of research and development which is the key to it they are really notional and token gestures.

In such a fast moving industry as this and where profits can be very high and also where the risk can be very high do you think that the financial institutions like Banks might be interested?
Well, basically they are frightened stiff of anybody who's talking about growth of above 10% per annum. As we are talking about 100 to 1000% per annum they really are scared out of their wits.

Secondly they take too long to deliberate they want market survey reports they want all this type of background information. In these early stages it's the type of guys who run things by the seat of their pants who are more likely to hit pay dirt.

You hear about the American companies continental companies Japanese companies all moving in parallel some in front some behind. If you get held up for three months for anything other than research and development problems which you know your competitors are facing as well then you may well end up being totally behind the rest.

What role do you think people like GEC and the other electronics giants have in this country as far as microcomputers are concerned, and what sort of role do you think Nascom Microcomputers has? Is it in competition or does it interface?
Until such time that the big boys are prepared to say Right we put X pounds into a high risk venture we spin it off as a separate entity. Until *that* happens they are not really going to get in on it. I read recently about Marconi Avionics going into specific micro areas which makes a lot of sense. But as far as microcomputers are concerned the giants involvement is zero. So Nascom's competitors are going to come from other board companies such as Ohio Scientific and perhaps price reductions on the Pet and the TRS 80.

These are boards very much aimed at the home or personal user. What other applications are there for boards such as your own?
Well the most obvious one is any industrial control application whether it be for the control of say a machine tool drilling tool grinding tool or whatever you like. With precision control you are currently talking about mechanically controlled machines which cost many thousands because of the very complex and archaic electronics. We are talking of reducing that to a mere few hundred pounds. Nascoms are already being used in prototype form in machine control. NAS GmbH (Germany) reckon they will be shipping 500 Nascom I's a month by the end of the year to industrial users so there is a big big market for what I call the board house and that's always really been our target.

We're trying to avoid getting involved in the Pet market. But I think that we may have to concede that that will be inevitable. It's a matter of how we divide our resources. The board companies are the only ones in a position to exploit the technical innovations and overcome the technical problems which the microprocessor has brought. It will be ten years before the average OEM has a big enough inhouse R and D section which can cope sensibly with microprocessors.

It's rumoured that much of industry in fact knows very little about microcomputers and

also doesn't really want to know too much. Is that a fair assumption?
I think the first part is certainly one hundred per cent true and is reflected by the type of questions and enquiries that we get from industry in general, and from the fact they bought Nascom 1's as Z80 evaluation kits to try and learn something about microprocessors. As for the latter point, I think that microprocessors/microcomputers scare the life out of the senior management of many companies. The non-technical management, those a little further down the line with the more practical day-to-day problems to deal with, I think are far more willing to grasp the nettle and to jump in with both feet. But if you are running a production line which has been going for ten years and you suddenly find that you can do everything with a simple board, then you, too, would be a little scared. Take my car, for instance; it's an expensive car but the electronics there are really ghastly — they must have been designed in the 1950's. You could reduce the cost of electronics in my car very substantially and you could make it far more sophisticated, far more reliable, far more effective, but that's going to mean chucking away a lot of tools.

What other applications do you see?
Well the sort of, how can I call it, the customised boxed microcomputers. As a consequence you can afford to build say as few as 3 or 4 or 4 000 with a totally specialised application. What I think is going to happen in the UK is there are going to be companies like Nascom who will have expertise to turn these things out, and we are going to be looking around for marketing organisations who are into specialised applications and have the finances to buy the hardware, buy the pre-assembled hardware, marry it up with a suitable software package and then market it as a finished product. That's probably going to be the biggest single market ever.

Are you talking about for industrial use or for domestic use?
Both. We've had a lot of interest shown in a package for Estate Agents, for example. It's centred around the Nascom 1 and requires a boxed system. It's the sort of thing we would in fact go into with somebody who has already developed the majority of software. We can develop the hardware easily enough and modify the software to suit the Nascom 1. The same would apply to virtually any professional applications, doctors, dentists and solicitors. There's a hundred and one possibilities. Then you move onto say teaching aids. Every school in the country could have, say, ten or fifteen Nascoms ready packaged, once again, with a number of software packages. But that's a finished article we would not necessarily build. We would look to other marketing or manufacturing companies to build the final box.

What sort of cost are we talking about?
Well it depends on how complex the parts inside but anything from £200 - £2 000.

In the home do you see the microcomputer being anything other than a toy?
Oh yes. I would say that by 1984/5 every house, say, being built for more than a current resale price of £40 000 would have a central computer which would control the heating, the lighting, probably the stereo. In fact, a hundred and one little applications could be built into the house just as the electric wiring and the gas and the utilities are today. By 1995 virtually every house in the country would have a computer because the obvious thing is energy saving, nothing could save energy more effectively than the microprocessor because it can regulate heating and lighting on a continuous basis to suit every conceivable condition.

Obviously, it's going to be an advantage to interface this with the telephone system, but do you think our present telephone system is up to it?
Well, firstly, you've got a legal problem. It is illegal to transmit and receive digital data down the telephone lines without the GPO's permission. Secondly, in many areas you've got inferior line quality. The GPO's gone some way along its path of replacing old land lines but it's definitely got a problem there. For instance, take the push button telephone: inside the push-button telephone sitting on my desk is a General Instrument microprocessor-based chip. It memorises the numbers as I stamp them out at any speed but it puts them down the telephone line at the same speed as it would if I were dialing with an ordinary dial. In America, for example, when you've lifted your finger off the last digit you've got the dialing tone — instantly. There's no delay factor and you can hit the keys as fast as you like.

So what's the next stage as far as Nascom is concerned?
The immediate stage is to consolidate our position. We have the Nascom 1 and 2 and several peripheral boards with a lot of other peripherals in the pipeline. You will see these products being sent out as mature items. The floppy disc controller is now ready, the RAM and bread boards are already out, we've got an EPROM board which has also an EPROM blower, we've got two graphics boards coming out, an IO board and most important of all, perhaps, a floppy disc around the Siemens 282 double sided double density floppy. That's 300K bytes of bulk storage per disc, which is a hell of a lot. Going onto other applications, we mentioned the office usage. There are two conflicting lines of thought on the development of the microcomputer here. One school would have you believe that it will follow the same path as the calculator. I don't think that it's going to be easy for the type of companies that are involved in the marketing of calculators to repeat the same success. They may well achieve 10-30% of the total market for microcomputers but I think there is so much support required, so much competent engineering back up required, that there are going to be problems.

> *'As we are talking about 100 to 1000% per annum thay really are scared out of their wits'*

Now to fly in the face of that argument, the biggest single manufacturer in the world of microcomputers is Tandy. It is turning out 10-15 000 per month. Pet reckon to do 4-5000. Nascom 1 2000. There is an enormous amount of back-up required. There are marketing forces and marketing people who would try to miniaturise microcomputers, but I think that it's going to demand a lot more competent back-up. Now if that is the case, to get that back up we're going to have to pay slightly higher prices because there's going to have to be pretty hefty overheads in it. So you are liable to get the market place split into defined areas. The home computer will be a high volume market, but people will be selling straight forward packages similar to the current TV games.

To a degree you can do that with small business systems. There will be a compromise at the end of the day between the mass marketing with the 'calculator' approach and the more discrete approach of the main frame. That will be where the small business system market is likely to end up. You still end up with a vast market segment that needs a hell of a lot of support, and support costs money, and that money has to be recovered somewhere or other, and it can only at the end of the day lie on the cost of a system. I think you will see a clear definition between companies who are just interested in buying and selling microcomputers and those who are actually producing them with a view to giving the support that's going to be necessary. Now whether that support is direct to the customer, to the end user, or whether it is via the sort of marketing organisation that I alluded to earlier, it is a separate issue, and one that has yet to be resolved.

What is your experience of the market situation in the States?
Well, in very general terms they are some 18 to 24 months in advance of us. They also have a different market. One of the things that is going to influence their market place in the coming months is whether TI are successful in their application for the home computer to be considered as a slightly different kettle of fish to a television when it comes to the FCC rules. In America you are not allowed to have a modulator on a microcomputer board unless it is an approved modulator. Now that is causing everybody all sorts of problems and there's litigation all over the place. The tendency, therefore, has been to move towards an in-built monitor such as the TRS80 which obviously circumvents any problems of that nature. Also you have a market place which, generally speaking, prefers the finished packaged product. I don't see the European market place maturing to that sort of level for some considerable time to come. What I do think is going to happen is that the market response to kits will decline. Also, we will probably have to move to developing quartz systems. This is a major difference between us and the USA. Another, I suppose, is that of disposable income. The average American enthusiast has a hell of a lot more income at his disposal. Where the average Englishman might eventually put £400 or £500 into a system, his American counterpart is just as likely to spend $2-4 000.

Whereas in the States they have technological innovations much sooner than we do, in England we have quicker access to these developments that the rest of Europe. England is definitely No 2 in this business.

Where does Japan fit into the picture?
I don't know where Japan really is. I have been told Nascom's low price products will go down very well in Japan because the Japanese domestic market has greatly inflated *resale* prices. We are not seeing very much innovation from them.

Can Britain hope to retain its position in the league?
I think we have an opportunity to grasp hold of and maintain second position. Not through building chips but through building *systems*. We are certainly held in very high regard by the USA/West Coast.

Are not Germany and France coming along very quickly? Germany has a reputation for being technologically advanced and the French have already announced they are going to push microcomputing in schools very vigorously.
I think the latter is probably more important than anything else. The sooner the need for well trained microprocessor engineers, both hardware and software, is recognised, the sooner we will get the show on the road. Right now that is the one reason why many OEM's are baulking at the prospect of producing microprocessor programs to power machines and equipment. I think that education is the key to the whole situation.

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SMALL IS EDUCATIONAL

It seems to be taking the computer world a long time to realise the educational potential of the micro-computer. That is not to say that no one has thought of the idea. On the contrary the Government acting through the National Computing Centre and the Manpower Services Commission has placed contracts and assisted with development finance in a number of areas related to the use of micro-computers in education and training. But the whole emphasis in government departments and educational and training institutions and in commerce and industry has been on teaching *about* micros rather than teaching *with* micros.

Following a long and often painful development of Computer Aided Instruction in the USA throughout the 1960s and scattered research in UK Universities, in 1973 Britain embarked on a National Development Programme in Computer Assisted Learning. For five years 30 or 40 groups in higher education, military training, schools and a few commercial organisations worked to move Computer Assisted Learning from a topic of educational research into a working educational technology — with some success. Indeed, with some considerable success, given the difficulties that the Programme faced. Using computers to teach all manner of things — Maths and Science as you might expect, but more you might not expect like remedial reading, geography, maintenance and fault finding, emergency drill — has a number of advantages almost *none* of which could be exploited given the institutional environment that the Programme worked within.

> 'the effects of the simulation are expressed as words and pictures on a screen rather than as a full physical simulation.'

But success there was. The role of the computer in teaching and learning can be thought of in many ways.

As a problem-generating machine for drill and practice. In Hertfordshire every week hundreds of school pupils receive problem sheets in arithmetic and mathematics generated by a computer. Completed problem sheets are returned to the computer for marking — which saves a lot of work — and (this is the clever bit) generation of next week's problems taking into account the strengths and weaknesses of the particular child as revealed by the computer's marking and the teacher's comments.

As an electronic book — using the old techniques of programmed learning but implemented in a new and more effective technology.

As a simulator of difficult, dangerous or expensive physical situations. Perhaps the ultimate form of this mode is the flight simulator. In the computer controlled simulator the trainee pilot can loop and turn, dip and wheel without the expense of flying a real aircraft and without the risk of losing it! More commonly the computer is used as an 'abstract' simulator. That is, the effects of the simulation are expressed as words and pictures on a screen rather than as a full physical simulation. Leaving out the mechanical gear that pitches and rolls a [illegible] mocked-up cockpit the TV and sound that reproduces the scenery and the noise and replacing them by a few statements — YOU ARE 1200M FROM THE SURFACE AND DESCENDING AT 117 M/S saves on costs and can still teach the student a lot. Using this kind of computer simulation, students of Nuclear Engineering at Queen Mary College in London learn to build and control power stations without the fear of blowing up themselves and half the City as well. They are typical of students of science and engineering throughout the UK who learn through computer simulations.

As an information resource. The computer is used for example in school geography lessons to generate maps highlighting particular aspects of a region. From stored demographic data any map can be specified and printed in quantity for classroom use. How else could you get a chart showing the geographic distribution of houses with two WCs in the Birmingham area? And who knows what social and educational implications that may have!

As a tutor and manager. The computer can be programmed to perform a variety of course management tasks from timetabling through to offering a trainee an assessment of his progress and recommendation on which topics to tackle next.

'Computer based material is reuseable time and time again at almost no additional cost.'

There are other ways of using the computer to assist learning and they all seek to exploit a powerful package of pedagogic and economic advantages.

Teaching with computers can be individualised, self paced and largely self instructional. It can save both students and teachers time.

Computers or at least computer terminals are portable. They can take training to the trainee, saving on the cost of residential courses.

Because material is individualised and self-instructional a trainee can start a course at any time. There is no need to wait until a suitable size group can be got together. That may save a few minutes at the beginning of a session or it may save months in an industrial situation where recruits come in ones and twos.

Computer simulations can cost only a tiny fraction of the cost of the real equipment. Where training on a simulator can be effective even for only a part of the training there may still be a substantial cost saving.

Overview

Simulations are safe. No one was ever killed by a flight simulator. So it becomes possible to use more realistic situations, even emergencies, in training.

Computer based learning has a certain charisma. Research results show a significant improvement in motivation at least in the case of some students.

Being taught by a computer can be private and impersonal. This privacy can be important especially in the case of older people and people retraining. Not everyone is willing to admit to ignorance in public.

Computer based material is reusable time and time again at almost no additional cost. This makes Computer Assisted Learning suitable for courses where there is enormous demand but also for courses at the other extreme of demand. It may not be economical to use conventional teaching methods for only one or two students at a time. But over a period of years the total numbers taking the course may add up to enough to justify the initial effort of creating self instructional material.

The odd thing about the National Programme was that it put so much emphasis on assimilation of computer assisted learning into the normal institutional environment of educational and training establishments, whereas it was these very institutional structures that made it so difficult to exploit the real strengths of computer based techniques. Educational and training institutions are dominated by group teaching methods. Classes are assembled to complete a course to a fixed timetable. Where individualised and self paced computer based learning techniques were introduced it was in small packets confined to pre-assigned slots in a timetable. And what if the student was able to learn quicker and finish the course earlier? He certainly couldn't go home — you can't go home until the end of term! It is much the same in training. A six week course is a six week course — finishing in five weeks only causes trouble!

So not surprisingly the Programme concluded that there was little material advantage to be had from computer assisted learning. The benefits were in quality rather than in cost or efficiency.

The personal computer changes all that. If the experience and expertise in writing computer based learning materials can be turned to writing materials for personal computers then individualised instruction comes into its own. That this transfer is a practical proposition is now being established by research workers. Indeed it is being discovered that the micro-computer has some substantial advantages over the admittedly more powerful timeshared systems previously used. In some work that my own company is doing with the Chemical & Allied Products Industry Training Board it has been found that the memory mapped screen of the Commodore Pet has enabled control and animation of the display that is not possible on any conventional computer system. And the reliability of the system is a positive gain. It is not that the individual micro is any less fault prone than other computers, it is just that if a micro malfunctions only one user is affected. A similar fault in a big system could take out a hundred or more terminals. It is clear that taken overall a group of micros will give more training hours than the same number of terminals to a timeshared system. And above all because the computer is personalised the training can be personalised and the intrinsic advantages of computer based learning realised.

Of course not all computer based training techniques can be readily transferred to personal computers. The flight simulator is a case where the very nature of the machine as well as its substantial cost will keep it strictly "institutional". But much can. English, geography and history, mathematics and science can all be taken to the home of the student who owns a personal computer. Its market appeal is parallel to the appeal of the encyclopaedia with the added advantage of interaction. A source of instruction that converses with you, helps you find your way through its store of knowledge, marks and assesses your progress, encourages and remonstrates.

'Accountancy, managament, legislation and much more can be taught by computer based packages brought to the exacutive's desk.'

The businessman can benefit too. Accountancy, management, legislation and much more can be taught by computer based packages brought to the executive's desk. The user has privacy of learning, control over where and when he learns. Sales training both of general technique and specific product knowledge is a promising area for this style of imparting information. And the personal computers on which it is based are totally portable. They can be taken from one place of work to another, passed from one trainee to another, used at work, at home, even taken to the customer's premises as a promotional aid.

The personal computer as an updateable source of educational and training material is a more important and ultimately bigger market than the games that dominate the software catalogues today. The clients are already there; it just needs the computer world to realise it.

Ken Knight is a director of Mills & Allen Communications, a computer systems company interested in "mass market" software. A wholly owned subsidiary of the film and poster advertising group Mills & Allen International, the Communications company is well known for its viewdata publishing service and its development of systems for computer based training.

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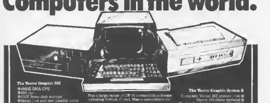

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COMPUTER AIDED LEARNING ON A MICRO

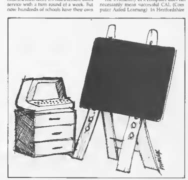
What the user needs.

For more than a decade, teachers have been fighting for computer facilities and, suddenly these have arrived. Only a few years ago, a school counted itself lucky if it had a reliable batch service with a turn round of a week. But now hundreds of schools have their own microcomputers and their number is growing every day.

CAL Historically

The availability of a computer does not necessarily mean successful CAL (Computer Aided Learning). In Hertfordshire after years of promoting CAL — writing their own software, producing associated teaching material, implementing and maintaining software stolen from elsewhere — they have with their mainframes, reached a situation where sixty fairly small CAL packages are, between them used some twelve to fifteen thousand times a year. A lot, compared to usage a few years ago, but even more significant because now they use CAL routinely in a range of disciplines. However, today's enthusiasm has not always been there and looking at some early attempts — and even at some now — it is a wonder that there are any customers at all.

The computer must indeed be a powerful teaching aid if, despite the dreadful mistakes made teachers with no commitment to computing for its own sake come back for more.



Cost-effective CAL

Educating children is very expensive. And we must make sure the things we give them to do contribute to their education. We must relate this to the time children take to complete their work, what they have learned, the resources (measured perhaps in teacher effort) preceding and following the lesson. Usually children are learning many things in parallel. As teachers we are probably only explicitly aware of some of these and so it is always difficult to quantify the cost effectiveness of any teaching strategy. At the same time teachers, head teachers and Local Education Authorities always have to make firm decisions on these issues.

There are other complications too Even if we found the best way to teach something, it does not follow that it would be best for all children, or for all teachers Further, children need variety so that in practice, we must look for a number of good methods

In this country we give teachers considerable freedom to use the teaching tools they think best (but within stringent financial constraints) Undoubtedly some teachers use computers — or any other piece of educational technology — because they are fun, or a challenge, or just because they are different Such motives should not be automatically derided A teacher is more effective if enthusiastic about teaching, he is then more likely to spend time on his preparation work So teachers fleeing to schools with CAL are perhaps voting with their feet A blunt method of measuring cost-effectiveness, but perhaps all we have

Who should write the material?

Partly because we capitalise on teacher enthusiasm and partly through tight money, we have traditionally used "free" teacher labour to write much of our CAL software Though often this happens because there is no one else qualified to write the program specifications it remains a fact that most CAL programs are written by amateurs There are aspects of the programs that are very good And if the teacher has had the right back up the materials woven around the programs that turn them into packages are as imaginative as any teaching materials produced by professionals But the programs themselves are often a different matter

In particular, the following defects are common

Even when programs are supplied with correct input, they sometimes produce wrong results or none at all

They are not sufficiently tolerant to bad data

Internal data sometimes contain errors

The mathematical models used are dubious

They take so long to run that no school could afford to use them

They are inconvenient — it is often impossible to correct data once entered or the format required for the input is unnecessarily restrictive

They all seem to use different styles of dialogue and conventions So any reader who masters a CAL package — be he teacher or student finds his experience of little use for the next package he comes across

Minifloppy discs are delicate things to put into the hands of children

Implementation

It is always difficult for a teacher to use teaching material others have written He prefers his own because of his allegiance to it, and forgives its faults Furthermore he has tailored it to his own requirements Of course teachers also use professionally produced material — shortage of time compels them to rely on outside resources And at least professional material is produced attractively and can be relied on In contrast, the handwritten duplicated work of colleagues or (worse still) an unknown from another school, is gravely suspect

All the same, software must be shared because of the time taken to develop it and its associated teaching material This forces the need for agencies to accept the "sows ears" teachers produce and turn these into "silk purses" The Advisory Unit for Computer Based Education in Hertfordshire, has been trying to do this for teachers in Hertfordshire and has built up a useful relationship with the teaching community there Though in a few years it will throw away most of what it has produced and we will be embarrassed by the defects of our current attempts in Hertfordshire at least there is an authority sharing software with teachers using others efforts as well as their own

Different kinds of CAL

Often differences in CAL are described in terms of the role the computer plays

Is it simulating an experiment conducting a tutorial providing an information retrieval service or providing drill and practice? These distinctions are often useful and there are other categories as well But in a school situation the teaching *style* that goes with a particular CAL package is at least as important It helps to identify four types

Interactive CAL Here the student works interactively using a keyboard a display and/or a printer

Demonstration CAL The teacher uses the package to demonstrate to a group of children so that they can all see the output Typically the responses to the computer become a matter for class discussion This activity demands a keyboard and a display — probably the school television monitor

Batch CAL At present this is a mainframe activity Children fill in coding sheets (ideally, purpose made for the package used) and these are sent off to be punched and processed Although less exciting, this type of CAL has advantages The technology does not give problems in the classroom it is not limited to one or a small number of terminals far more output is available without the user taking too long at a single terminal

Computer Managed Learning This is usually not regarded as a branch of CAL, but it is convenient to discuss it now Here, the computer provides more of an administrative aid to the teacher and is typically used in an individualised learning scheme By marking some or all of the students' work, the computer attempts to free the teacher from some of the organisational problems attached to individualised learning This leaves him free to give more attention to students with particular problems

Where do micros come in?

All that has been said so far is based on mainframe experience Like every other educational authority Hertfordshire is only just beginning to appreciate the additional problems that go with a micro

True, there are one or two things that become easier too, including

No phone complications

No logging in complications

Predictability of response times Even if a micro is slow it can be relied on to produce results with a time consistency that mainframes (almost by definition overloaded at times) cannot guarantee

The ease with which micros can be moved around and set up in different classrooms

The crude but effective graphics that they often support

In addition when — through inefficient administration — things go wrong it tends to hurt in the right place

However, there are drawbacks too In particular

Backing storage is unsatisfactory and/or expensive Cassette tapes are slow minifloppy discs are delicate things to put into the hands of exuberant children

Applications software maintenance if it becomes a school responsibility is a huge task

Sharing the production of manuals software and teaching material between schools is not so easy to achieve Even if a particular Local Education Authority has a policy of equipping schools with the same micro slight differences in the configuration (memory size or version of the executive) can create chaos

They are slow

To get hard copy extra money must be spent Not only is hard copy essential as evidence to examiners of project work it is also necessary for teachers to discuss an on-line session with a student afterwards

As yet there are some CAL packages which are too large (or which employ data files which are too large) to fit into a micro

But microcomputers are here to stay so we have to live with their inadequacies The most worrying problem is the exchange of software and Hertfordshire is solving this by linking all the micros to the mainframe The software that does this allows the micro to

Act like a VDU terminal (but one capable of storing a complete on-line dialogue on cassette tape)

Transfer software between the computers so that utilities on the mainframe can be used to process the microprograms and so that the micros have access to a centrally maintained library

At present these links are too slow and it is not easy as (say) using a slide projector — and some people can make a mess even of that But the method does ensure that co-operation and exchange continues There are plans to in future use Prestel for this purpose and this will enable Hertfordshire to communicate with users in other Local Education Authorities as well

Dr Bill Tagg is at the Advisory Unit for Computer Based Education in Hatfield Hertfordshire

A TINY PILOT
AND
ITS MACHINE

A school teacher's concrete computer experience. One language mentioned, PILOT, has been specially designed for Computer Assisted Learning, and will be looked at in some detail from the fourth issue onw[illegible]

Alec Wood teaches at Wirral Grammar School for Boys, Cross Lane, Bebington, Wirral, Merseyside.

The computer age arrived at Wirral Grammar School in January of this year. That was when the Physics Department's Nascom 1 arrived.

Now, before you dismiss this with thoughts such as — just a development toy — let me add that by summer we were able to analyse 900 pupils' internal examination marks a year group (220) at a time, adjusting the marks to give a mean of 50 and obtain, simultaneously, position in form and position in year group. This greatly simplified the job of setting in the upper school. There are fifty pupils studying physics in this year's lower sixth and the computer helped to sort them into three theory and four practical groups. We also now run our own version of Pilot (Wirral Pico Pilot) and the computer is used in the classroom during General Studies lessons, as well as by pupils in the lunch hours *and* by the Digital Electronics and Computer Club.

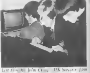
Left to right: Keith C[illegible], Peter McCh[illegible]ey (who has just completed his own 77-68 CPU board)

Our 8 Kbyte memory expansion is nearing completion and plans for the immediate future include a printer and graphics facilities. By this time next year we also hope to see the microcomputer used by individual pupils for Computer Assisted Instruction (CAI) in physics, and perhaps other subjects as well. Further administrative tasks should be possible, such as constantly updated form lists during the period of flux at the end and start of each school year. The graphics should allow useful simulations during lessons and the plotting of results both as bar and line graphs.

Twelve months ago we had had little hands-on experience of microcomputers but now the school's Nascom, my own Nascom, a sixth former's Sorcerer and a fifth-former's 77-68 are all available to the electronics club. Acquisition of knowledge and development of hardware and software skills appear to be exponential (to be verified when we obtain graphics!), so we look forward most optimistically to the future.

Had I been able to make a completely free choice at the time, with no financial restraints, I would probably have purchased a much more powerful machine immediately, rather than rely on future expansion. In retrospect I am not now so sure that this would have resulted in our making maximum use of the system any sooner. I am primarily a teacher — not a computer systems expert — so the time I can give to developing the use of the computer is limited. Even if we could have afforded a more powerful machine, and had purchased 'off the shelf' software, considerable time would still have had to be spent (a) learning to operate it and (b) adapting the software to our precise requirements.

As events have turned out we were able to use the Nascom as an administrative tool as soon as we had learnt to program in machine language. This was closely followed by the implementation of a simple



Left to right: John C[illegible] [illegible]K Sorcerer [illegible] C[illegible] Simon Stringer (2nd form [illegible] Form[illegible]) high-level language that has allowed even junior pupils to write "programs" within minutes of sitting at the keyboard. During this time I have been able to develop much clearer ideas of the system I would like to see in the future. If, that is, money ever becomes available. These ideas include a multi user system linked to the administrative office, as well as to a teaching area and a disc system to allow the use of several high-level languages and the storage of large data files.

However, coming back to earth, let me say some more about our present system. At first it was regarded as an expert's machine and mnemonics were flying around in all our conversations. Only the physics staff and several pupils had enough courage to enter the same room as the computer, and a few were actually prepared to try and master the input of hex codes.

Questions from other staff, with some experience of programmable calculators, such as "It won't be of any practical use if all the programs have to be in hex will it?" and "Is all the output in binary?" pointed to a major problem. If the microcomputer was to become accepted quickly and was to be of *real* use it *had* to be capable of being handled by the rest of the staff in much the same way they would any other piece of office equipment.

At this point, work was started on the "Mark Handler" program. We decided that the program must be so simple that staff were unaware that they were using a computer. All input and output obviously had to be in decimal, but the output also had to be in a readily digestible table format. Automatic counting of the number of pupils in each form was included so as to prevent operator error at this point and provision was made for an absence to be indicated by "ab" against a pupil number. Results are displayed in five columns: Pupil number, original mark (raw score), adjusted mark, position in form and position in year. These are displayed in "pages" on the screen, fourteen pupils at a time, until the end of a form, at which point the message "press N for next form" is displayed. Letter grades may be selected instead of adjusted marks.

Even when all this was achieved I am afraid the odd "Luddite" was heard to remark, "I can do it quicker in my head. It's like calculators — they never give the same answer to the same problem twice." At the moment results still have to be copied down by hand from the TV screen, but once we are able to obtain hardcopy I feel that this initial reluctance may change. Staff will be able to obtain an immediate printout and take it away to check. Those hesitant at first in using the keyboard will probably also be able to find a colleague willing to oblige, and you never know, this task may even be delegated to the administrative staff! The use of such a program also makes it administratively very simple to *compare* the results of each department throughout the school year groups, and this might also lead to some reluctance to use the computer.

A simultaneous, but most welcome, problem that became evident was that pupils playing various games on the computer had their imaginations stimulated. The request "Please show me how to write a program" became more and more common. Although senior pupils were willing to try and master machine code, the lack of immediate results dampened the juniors' initial interest. Machine code was also not particularly convenient for demonstrating the concept of a program to the General Studies groups. To fulfil these two requirements "Wirral Pico Pilot" was born.

The aim was to produce the most powerful interpreter possible that would reside in the Nascom's limited Random Access Memory (RAM) and yet leave sufficient RAM space for useful demonstration programs to be written. We also hope to write useful Computer Assisted Instruction programs once the 8 Kbyte memory expansion is built. The specification of Wirral Pico Pilot and sample runs of a demonstration program are given at the end of this article. Any school that would like a listing of the interpreter and of the mark handler program is welcome to a copy if they send a cheque for £3 (to cover duplicating and postage) to me and made out to WIRRAL GRAMMAR SCHOOL FOR BOYS. The address is Cross Lane, Bebington, Wirral, Merseyside.

> *The odd Luddite was heard to remark, "I can do it quicker in my head. It's like calculators — they never give the same answer to the same problem twice"*

You have probably gathered by now that our Nascom is a departmental computer and not a school system. The local education authority still have plans to install a terminal and this may or may not come about. I have mixed feelings over this as the running costs will be high, no matter who pays them — the authority or the school — and the money could perhaps be better spent buying several microcomputers and ancillary equipment over the same period of time. However, with the present cutbacks in educational spending, I wouldn't be surprised if we didn't see either. I do hope that such cutbacks do not prevent microcomputers reaching more schools quickly. *Secondary schools should reflect the world around them and the obvious place to introduce everyone to the computer is at school whilst they are most adaptable and open minded.*

The departmental computer has become a possibility and it would be a pity if lack of money prevented it from becoming reality.

Left to right: John Clegg, [illegible] of the Nascom 1s, Simon Stringer, Paul Adams, Ian Crossley, Simon Banton

If any head of department is thinking of taking the plunge, but cash is very limited, may I recommend the Nascom 1. Good working secondhand models are now being advertised in magazines for under £200. I paid £145 for my own personal Nascom. Modifications to it cost me £5.03 and a superb verocase cost £25. Most schools will almost certainly already have a suitable television & cassette recorder. For classroom use I managed to resurrect an old 28" black-and-white video monitor that had been gathering dust in the corner of a classroom. This can be driven directly from the Nascom's B/W TV at the keyboard.

Joining a local User Group is also very worthwhile. A colleague, a senior pupil and myself attend the local Merseyside Microcomputer Group and Education Subgroup meetings and we have found the exchange of ideas and information most useful. I also recently attended the Nascom Users Subgroup for the first time and am sorry that I had not attended earlier meetings. There is no doubt that the best way to learn about your particular machine is to meet other people who also use one.

At this point it might be appropriate to say a little more about Pico Pilot. There are already tiny versions of Pilot available for the Nascom but I rejected these because they were not true string-handling versions. They would only accept an input of a single character, and the match statement, which should be the most powerful of the Pilot operations, was not considered sufficiently versatile in that it would only perform one match at a time. It was decided that to be of any real use Pico Pilot must be capable of accepting and matching a string of at least one screen line (48 characters). In the end 45 characters was achieved and this was considered close enough. Pico Pilot also had to be capable of accepting answers as either digits or words and be capable of accepting the correct response on its own but rejecting an incorrect string containing the correct response, that is, to be capable of rejecting — "the answer is 210", "the answer is 102", "three hundred and ten", but to accept — "the answer is 10" or "the answer is ten". It was also considered desirable to be able

Front: Ian Crossley Back: Simon Banton Anthony Byers

to print out any input again under program control to give a "chatty" dialogue between computer and operator

To help reduce the length of the actual programs that were to be written using the interpreter it was felt that the match statement should be capable of matching with one of several strings (match or) and with a given sequence of strings (match and) Existing Pilot interpreters capable of running on a standard Nascom fell far short of these requirements and really only had novelty value as they did not exploit the true capabilities of Pilot as a language for computer assisted instruction

The following sample output from a program will, I hope serve to demonstrate the versatility that was finally achieved with Wirral Pico Pilot

SAMPLE OUTPUT OF DEMONSTRATION PROGRAM 1

```
TYPE IN YOUR NAME
   NO
VERY FUNNY
TYPE IN YOUR NAME
   SMITH 129764397A
SMITH 129764397A SOUNDS LIKE A CONVICT
TYPE IN YOUR NAME
   GOD
VERY FUNNY
TYPE IN YOUR NAME
   GODFREY SMITH
ISN T  GODFREY SMITH  A BIT FORMAL
WHAT DO YOUR FRIENDS CALL YOU
   GODFREY
NOW WE ARE ON FIRST NAME TERMS GODFREY
LET S TRY A QUESTION  WHAT IS THE VALUE OF
THE ACCELERATION DUE TO GRAVITY?
   210
NO
TRY AGAIN
   ONE HUNDRED AND TEN METRES PER
SECOND
NO
TRY AGAIN
   98 METRES PER SECOND PER SECOND
NO  BUT THE UNITS ARE CORRECT
TRY AGAIN
   I M FED UP  THIS IS MY LAST TRY  10
GIVE  ME  THE  10  AGAIN  WITH  THE  CORRECT
UNITS
   TEN METRES/SEC SQUARED
CORRECT
```

You've read that of Alec Wood [illegible] experience at [illegible] Look for a different [illegible] from [illegible] PILOT for the 6800 [illegible] — Dr Jesse C [illegible] of Western Washington University Washington State USA This article will appear in [illegible]

DEMONSTRATION PROGRAM 1

```
U 4
A
U 5
YJ 1
U 6
YT $ SOUNDS LIKE A CONVICT
#YU 3
YJ 0
M
YT ISN T  $  A BIT FORMAL
YT WHAT DO YOUR FRIENDS CALL YOU
YJ 0
T NOW WE ARE ON FIRST NAME TERMS $
T LET'S TRY A QUESTION  WHAT IS THE VALUE OF
T THE ACCELERATION DUE TO GRAVITY?
A
M N&T&KNO QUIT
YT 10  M/SEC  SQRD
YE
M  10 10  AND
YJ 1
M 10 TEN
NJ 1
YU 2
YT CORRECT
YE
T GIVE  ME  THE  10  AGAIN  WITH  THE  CORRECT
UNITS
J 0
#U 1
YT NO  BUT THE UNITS ARE CORRECT
NT NO
T TRY AGAIN
J 0
#M M&/$S&S M&PER&S&S
E
#T TYPE IN YOUR NAME
E
#M GOD  NO"
YJ 1
M GOD,NO  LOST
YT VERY FUNNY
E
#M 1,2 3 4 5 6 7 8 9 0
E
```

continued on p72

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ALGORITHMIC DESIGN OF MICROCOMPUTER PROGRAMS

Bimonthly Series

1. An introduction to structured programming.

What are good programming habits? Structured Programming? Languages suited to micros? In this Bimonthly series Dr Martin Beer of Liverpool University Microcomputer Laboratory discusses approaches to these essential topics.

This is the first of a series of articles intended to show how modern programming techniques can be applied to microcomputer programming. The areas covered will include systems design and programming, the systematic use of various programming tools and the generation of a suitable programming environment.

I do not intend to restrict the discussion to the use of any particular programming language or microcomputer system since good programming practice considerably eases the writing of clear, maintainable and error free programs, no matter what language is used. If Assembler or older languages such as BASIC or FORTRAN are used self-discipline is required to ensure that the rules are obeyed whereas with block-structured languages such as PASCAL and ALGOL 68 the form of the language is such that, in general, the rules *must* be obeyed. Although no programming system can ensure that you write only "good" programs, systematic programming will help you considerably.

I will in this article discuss some aspects of control structures and introduce you to some of the concepts often described under the generic title "Structured Programming."

In the next article I shall expand on the algorithmic design of programs and discuss the usefulness of top-down programming and the advantages so available for the average microcomputer programmer.

The ideas behind "Structured Programming" have been discussed widely by academic programming specialists for about ten years and are being used in commercial programming in an attempt to establish recognised standards.

Programmers are a very individual breed, and everyone of us has his own way of solving common problems. In the early days of computing it was indeed usual for programmers to go out of their way to write confusing and unfathomable code to gain some, often mythical speed or storage advantage. And having used some recent offerings from the micro-software houses, I can see that this breed of programmer is still far from extinct! Individual programming was fine so long as the programmer was still around to sort out any problems that arose once the program was in regular use. But what if he left or was working on another project? Some one else would have to work his way through each step of code and try to find a solution. This search for the needle in the haystack frequently meant it was cheaper by far to rebuild the program from scratch!

With microcomputer software the problems of maintenance are far greater since the program is likely to be distributed to many users widely spread geographically, with few specialist programmers available locally. And if the program has been distributed in Read Only Memory the problems are even greater. For since issuing corrective patches is impossible new memories must be manufactured and released through the dealer network, with all the extra cost that results. It is, therefore, essential that if programs are to be maintained, you should have reasonable confidence in their operation under normal user conditions from the start. If problems occur later no matter from what cause, their effects should be limited to as small an area as possible so that the true cause can be isolated pin-pointed and dealt with quickly.

There is always the temptation when a program fails and you are under pressure to get your micro working to deal with the symptoms rather than the cause of the problem. This is highly dangerous — you are sowing the seeds of another failure a failure which, next time, will be horrendously more difficult to fix, since your own patches may well get in the way.

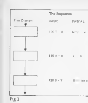
I intend, now to look at how a long program can be broken down into manageable sections. Writing even a comparatively short program is not a monolithic task that must be completed all at one go. If sections are completed and tested individually there is a far greater chance that the program, as a whole will work once it is completed. When problems do occur their cause can be isolated by testing the sections individually. This reduces the time and effort needed to obtain the final version.

So, a structured program must be made up of a series of independent sections each of which should

- perform only one specified task
- complete the task satisfactorily before continuing
- have only one entry point
- have only one exit point
- be composed of a program statement or other sub sections which perform various sub-tasks and which themselves strictly satisfy all these conditions

Each section must be independent and not include jumps to code in other sections, since this would violate the rules about entry points and exits.

If these rules are followed correctly each section of your program could be coded as a separate subroutine. But this is



```
100 T   A        temp   a
110 A = B        a   b
120 B = T        b   temp
```

Fig 1

rather extreme and would make the program as a whole difficult to follow. It is therefore usual to define subroutines for those tasks which are likely to be called in several places or when the task is so important that its programming is a major step forward towards the completion of the project.

No programmer can be fully familiar with the whole of a very long program for the time taken to write and correct (debug) it. Sections should therefore be of such a size that you can work on them comfortably. It is often convenient to restrict the length of each section or subroutine to at most one sheet of printer output, or one to two screens on your VDU, since this is the most convenient length of code to both study and edit.

It has been realised for some time that only three control structures are actually required to write any program. They are

a) The *sequence*
b) The *condition*
c) The *loop*

Apart from the *sequence* in which each program statement is executed sequentially (see Fig 1) most programming languages allow the programmer alternative forms of each of the above. Whilst only one form is actually needed this sometimes means a rather awkward syntax may be used. Allowing a limited number of alternatives to handle the most common requirements allows us to write far more elegant programs.

The *condition* allows you to write programs which can deal with a number of different situations. Without it a different program would be needed to handle every minor variation in the specification to which the program is to be written. This clearly would make the computer far less useful.

Conditions can be subdivided into

a) Single Branched
b) Double Branched
c) Multi Branched

classes though all possible algorithms can be expressed as a special case of the one branch condition known as the *conditional branch* instruction. In BASIC for example, it is

IF I = 0 THEN 3000

Examples of conditions of all the above types are given in Fig 2. Most computer languages provide special syntax for two

Algorithmic Design

it not all three condition types. Although this leads to some redundancy, in that the same program can be written in a number of different ways, it allows shorter and more meaningful code to be written.

One branch conditions of the type

IF *condition* THEN *do something*

have been used by programmers since the earliest days of computers. Indeed this is the only condition provided in the instruction sets of most microprocessors. Unfortunately, most programming algorithms require the use of a two-branch condition of the form

IF *condition* THEN
    do something
ELSE *do something else*

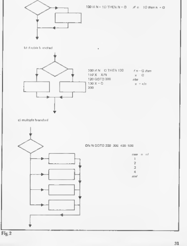
The lack of this condition (two-branch) is a major deficiency of many non block structured languages such as BASIC and FORTRAN. In these languages, to obtain the same logical flow a series of conditional jumps is required and the underlying structure of the algorithm is lost. A number of attempts have been made over the years, to add this feature to both, but none has so far proved to be fully satisfactory.

With block sttructured languages such as PASCAL the

if   then   else

construction where each of the branches may itself be a program block, has proved to be much more satisfactory, and fits in with the use of systematic programming techniques, as I hope to show in later articles.

The multi branched condition, commonly known as the CASE clause, reduces the need for deeply nested IF statements. For example if different actions are required depending on the colour of an object



```
100 II N = 10 THEN N = 0        if n   10 then n = 0
```

```
100 if N   0 THEN 130        if n = 0 then
110 X   X/N                    x   0
120 GOTO 200                 else
130 X = 0                      x  = x/n
200
```

```
ON N GOTO 200  300  400  500
                                 case  n  of
                                  1
                                  2
                                  3
                                  4
                                 end
```

Fig 2

we can write the code in two equivalent ways, the first using CASE the second using nested IFs Notice how the first way is far more compact

```
case  colour of
          red
          green
          yellow
          blue
end
and
if colour = red then

  else
        if colour = green then

           else
                if colour = yellow then

                   else
```

Most readers will follow the underlying logic of the first piece of code much more easily than the second

The program *loop* is very important since it allows you to repeat a series of operations as required, without having to duplicate the necessary code Whilst loops can be constructed from suitable program sequences and conditional jumps this is very laborious So most programming languages include a number of constructions such as

a) loop *while* condition is met
b) *repeat* until condition is met

Algorithmic Design

c) repeat a set number of times (possibly forever)

Examples are given in Fig 3 BASIC has a special statement for the third construction (the FOR loop) only, but the other two can be formed readily by using conditional branches

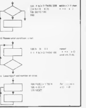


Fig 3

There has been some discussion as to whether both the *while* and *repeat* clauses can be rewritten as *while* clauses This argument does not allow for what happens when the loop is entered with the exit condition set Using the *while* clause prevents execution of the loop whereas using the *repeat* clause ensures that the body of the loop is executed at least once

A great temptation when writing any program is to think it will be needed only the once, and therefore no great care is required in its design and programming This is a great mistake Any program is potentially a valuable addition to your library, and may be swapped, or sold to other users who have a similar problem to solve So it is essential that the program is carefully constructed and coded from the start, as otherwise it may have to be effectively rewritten before full use can be made of it

Using the programming practices described in this series of articles does not absolve the programmer from writing documentation telling himself, and others how to use the program What these practices do, however is to ease the task since the program itself should then be relatively easy to follow Plenty of sensible comments and meaningful variable names help in this also

Under no circumstances should programs alter their own code, or interfere with the normal operation of the micro computer so that the system software cannot recover from an error

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HOW MIGHTY MICROS CAN AID SUPER SALES

Whether you're selling nuts and bolts or power stations, the same sales disciplines apply. A Sales Manager needs to know *who's* going to buy *what* and *when* — he also needs to know that sufficient effort on the part of the salesmen is being made to ensure that all the promises come good.

Salesmen, in turn, have to maintain records concerning all prospective business — reflecting the who's going to buy what and when situation for their own territories. Needless to say, salesmen being at the "sharp end" have to *make* the promises come good! Yet much of salesmen's and sales managers' time is taken up with administration — up-dating mailing lists, prospect product analyses, call reports — to name but a few tasks.

Indeed, the common enemy for sales managers and salesmen alike is time — time spent on administration is time not spent bringing in orders. Therefore any method which can reduce administration time will benefit sales — such time saving methods can be found through use of microcomputers.

In concept, the microcomputer can provide the sales office with an information base on all prospective business.

A file, such as shown in fig 1, would be maintained for each prospect so that at the touch of a button, selected details on any prospect can be retrieved.

In practice, a twin-disc microcomputer would probably be used. Each salesman would have the responsibility for maintaining his own disc file of prospects, with the sales manager having a summary disc of all sales activities. Fig 2 shows in diagrammatic form, typical reports that can be generated from the information base (fig 1).

One of the age-old problems with computers is the amount of "bumph" created. However, microsystems, properly programmed will only produce the information required and not hide it amongst pages of continuous irrelevant data. For example, fig 3 shows a typical contact listing for a salesman. In this case, he 'asked' the computer to produce a listing of all prospects for two products — an action that takes seconds. His alternative would have been to wade through all his prospect cards, eventually producing a list, but his selling enthusiasm would be on the decline.

The key to the success of using microcomputers in selling is in the specification of the information base and the design of software. As a rule, it is better to have too much information stored than too little.

For example, from the information contained in the file shown in fig 1, a market

Prospect Company Name
Contact Name
Address (three lines)
Telephone Number
Salesman Name
Sales Branch
1st Month on Prospect File
Anticipated 'Close' Month
Date of last Call
Anticipate Delivery Month
Percentage Rating
Discount Code
Credit Limit
Industry Code
Number of Calls to Date
Product Details

Fig 1

ing group may determine the average "close" time per product per salesman — and even include the seasonal trends This might also be analysed by geographical location or industry

At a later stage long term sales planning may be aided by the inclusion of what might appear (at first glance) to be irrelevant information

This is really where the importance of software design comes in Whilst some sophisticated micro systems have high level report generating software packages which enable virtually any report to be obtained within minutes — such systems often price themselves out of the sales de

Marketing

partment budget The norm would be to write the analysis programmes in BASIC or some such language However it s not my purpose here to detail the writing of such programmes, but to outline the application

From the main information file, subsidiary files can be created to hold such data as lost orders — where lost order details are added at the time of file creation Similarly, as sales orders are gained, additional order information can be added to a newly created order file so enabling an analysis of reasons why sales were achieved — a great aid to marketing

Whilst only briefly outlining the potential of a prospect system, it can be seen that there are many benefits both for sales management and staff

- Reduced sales management paper work
- More time for sales management to assist salesmen with selling
- Faster access to vital sales pipeline data
- Back-up marketing feedback provided
- Strengths and weaknesses shown — where action can be taken fast
- Excellent selective mailing database for ongoing marketing
- Product and industry buying trends available more quickly — vital for onward marketing strategy

But, the benefits don t stop there Whilst prospecting and closing business is the major function of a sales force, there are many other time consuming administrative tasks within the department One such task that cries out for automation is the production of quotations When a customer asks for a written quotation the salesman has to put together all the details and have the final quotation checked for validity — delivery pricing customer discount etc As most of the data required is carried on the prospect file the production of a quotation is almost automatic From then on a separate file of quotations made can be retained and used for follow up It also provides a very good link to an order entry and general accounting system, if so designed

Pricing for quotations may be kept on a separate pricing file if the type of products so allow Information on product delivery product discounts minimum order quantities product configuration and geographical maintenance charges would be held on such a file The benefit of having a pricing file is that products may be inserted and deleted simply — general price increases take seconds as opposed to days of checking — V A T rate changes may be accomplished in a fraction of the normal time required

How can a sales manager justify such a system within his organisation? Taken simply, there should be sufficient justification on time saving alone — the cost of a sales force of one manager and three salesmen plus four cars and expenses would be well in excess of £30,000 per annum A time saving of 5% over three years would justify spending £4,000 The selection of the microcomputer should be made with care and thought to the future It will take a relatively short time for a simple system to be up and running, but as the benefits and capabilities of microcomputers become known, more applications will come to mind perhaps requiring additions to be made to the original machine — one such addition could be a typewriter-style printer for specialised word processing

So if you re in selling why not take a look at your office and see if the mighty micro can help you achieve even better sales — you could be pleasantly surprised

Tim Walker is a principal of Computrade

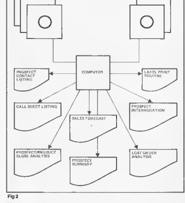
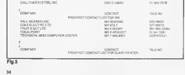


Fig 2



```
J
COMPANY                                   CONTACT              TELE NO
                    PROSPECT CONTACT LIST FOR COMPUCORP 625
CALLTHATCH STEEL INC                      DAV D J MAG          01 340-7878

J
COMPANY                                   CONTACT              TELE NO
                    PROSPECT CONTACT LIST FOR 388
BALL-BEARING INC                          MR BEARING           223-88456
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7
J
COMPANY                                   CONTACT              TELE NO
                    PROSPECT CONTACT LIST FOR SLAVE PR NTER
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Fig 3

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John Braga

WHY NOT A COMPUTER IN YOUR BUSINESS?

A solicitors package from Oyez, implemented on a Jacquard Systems J500 small computer

In this, the first article in a series for "first timers" in business computing, the author discusses prices as a yardstick, how to evaluate a system relevant to your needs, the bad news, the good: packages — off-the-peg and bespoke, salesmen, assessing packages and testing them.

The fact that you have picked up this magazine shows that you are at least considering the above question. How far have you got with thinking about it? If you are at the stage where you have decided a computer is not for you (shame!) or, alternatively, if you have already settled on a system, then you can pass on. The majority of readers, however, are probably in the position where they are feeling very ignorant about computers, and unsure of where or how to start evaluating them. If this applies to you please read on!

The last two years or so have seen an incredible revolution in computers — so incredible that many businessmen have missed what is happening under their very noses. The advent of small, cheap and very powerful machines has been so sudden that many people who should know better prefer to take the easy option — to ignore the microcomputer and hope it will leave them in peace. The worst offenders in this respect are, strangely enough, those already working in Data Processing. I can only think the reason for this is that the very cheap prices being asked make a nonsense of some more traditional systems. Price has always been a useful — if rough — yardstick in comparing systems. If System A costs £20,000 and System B £5,000 it has been reasonable to

The author outside his Nottingham computer shop assume that System A may be approximately 4 times better The microcomputer makes this convenient rule obsolete and makes it far harder to compare systems Hence many consultants are suddenly finding they have to go back to school to relearn

We are now at the stage where a computer can be bought for anything from £500 upwards Can one really perform useful business functions on such a machine or are they only useful for playing Startrek? Why is an invoicing program advertised for £12 by one company and £1 000 by another? How does one sort out the bewildering array of systems being offered, with new arrivals on the scene each week? This series of articles is intended to answer these points and show the businessman what he can expect from a computer system how to set about getting what he needs and how to install it when he has got it But first the basic question *How should you evaluate a computer system?*

If many computing 'experts' are out of touch, how on earth can you cope? Ignorance breeds a feeling of helplessness You are perhaps reluctant to ask advice from computer salesmen, knowing that they are prone to rattle off solutions which you have no means of evaluating How about those horror stories you dimly remember about firms who installed computers and ended up paying more than before and without any tangible benefit? Would you also be exchanging a known set of problems for an unknown — and more complicated — set? It is after all, so much easier to take the easy option and forget the whole idea (and you can tell yourself that it is for the best possible reasons!)

First the bad news

I must admit that computers are a complicated subject It takes an effort to understand them but it is an unfortunate fact that the value of the computer system you install will be directly proportional to the amount of effort you yourself put in You cannot delegate the computer decision because it will fundamentally affect the way your company operates I do not mean that you have to learn to program nor do I mean you have to understand electronics But you *do* have to learn about what a computer is capable of (and what it is *not* capable of!) and you do have to spend time thinking about what you really want it to do in your company What is the priority task that can save you most money? And this last question alone can involve you in a considerable amount of thought!

Some generalizations

Having said above that computers are complicated let us make them easier by reducing them to bare essentials In a small business system you enter data via a *keyboard* The data that you have entered plus the replies that the computer makes are displayed on a *screen* The data is stored first in the computer's *memory* and later (because the computer forgets everything, when you switch it off) on some more permanent storage such as *disc* The data can then be analysed by a *program* and the results displayed in a great variety of forms on an output device such as a *printer* There are endless variations on the above theme but keep that picture firmly in your mind as a starting point

Now many people who have got this far make their mistake at this point They rush out to evaluate hardware (jargon for the tangible bits you can see such as the computer the printer the screen etc) and forget the most important element altogether — the software The software is the program — the long complicated series of instructions written by experts that turns this interesting (but dormant) heap of electronics into a super clerk that prints your invoices, keeps track of your debtors reminds you of appointments values your stock and so on And I must admit that some salesmen encourage this error because the hardware is much easier to produce and sell than the software Since the coming of commercial computers in the late 1950s people have consistently underestimated the amount of effort required to produce good programs — and they are doing it still!

'It is a lot easier to judge the look of a ready made suit than a roll of cloth'

Off-the-peg package

So I am going to be perverse by suggesting that you start evaluating a computer by actually ignoring the computer! Look instead for a program package that will do most of what you want This may be compared with shopping for hi-fi You have to keep reminding yourself that you are seeking a good *sound* Appearance, size, styling are all important too but the sound should be far and away the most important factor

Similarly with computers if you decide, for example that the first priority is a system that will print your invoices every week do not be beguiled into considering a clever box of tricks that prints most attractive stock lists! Insist on seeing invoices entered at the keyboard and printed by the machine Insist too on trying it yourself or on bringing in your secretary to try it if she will be the one using it regularly It may be a very large and expensive step to add invoicing to a system that has not got it

In fact choosing a program package has a lot in common with buying a suit You first of all have the fundamental choice to make between off the peg and made-to-measure While you may prefer the latter you recognise that the former is likely to be cheaper — and may prove just as satisfactory if you can find a suit that is a good fit Similarly with software if you can find a package that suits you it will *certainly* prove cheaper — probably by a large margin — and so it is worth looking around (There is also the other major advantage that it is a lot easier to judge the look of a ready-made suit than a roll of cloth!)

If you do succeed in seeing invoices produced you will be able to judge two important factors

- whether the system produces invoices that are anything like your invoices
- whether the salesman knows anything about your type of business

The first is important because it will be much easier to implement a good invoicing system if it has already been written, documented and tested The second matters because you cannot turn yourself into a computer expert overnight so you must judge whether or not you can trust the salesman While you accept that he is biased towards selling you a machine it is important that you find one capable of asking the right questions, of evaluating your requirements and of choosing which system to propose (or does he only sell one type anyway?)

If the salesman cannot show you invoices being produced then it is most likely that he has not got the right program package His reaction will then be worth watching! If he hints that you can easily write the program yourself, then I can only suggest you look elsewhere Yes you can learn to program but only if you devote considerable time to it To continue the 'suit' simile above, this is akin to being offered a pair of scissors and a roll of cloth By all means learn to program — it is a fascinating art and a useful skill — but practise on a simple and minor task, not on an application that is vital to your company's success! Avoid this type of salesman like the plague.

What if no suit fits?

If the salesman suggests a program can be written for you then you are in the area of 'bespoke' software rather than 'off-the-peg' By all means consider this — it is sometimes the only solution that makes sense — but you must recognise that the costs are likely to be considerably higher In general, consider it only after you have checked whether a program package is available elsewhere We shall be suggesting ways of getting software written for you in the next article

What you should expect

Let us imagine that you have settled on invoicing as the first priority You are being shown a package that prints invoices How do you assess it?

A good programmer with a knowledge of commercial procedures can write a reasonable invoicing program in a fortnight or so, and an excellent one in a month Unfortunately, before his efforts can be made saleable he will need to spend at least twice as long again providing two important additions

Good documentation
Error proofing

- Documentation is the first hurdle and many good programmers fall at it. If the documentation is limited (and it usually is because it is tedious to produce and difficult to update) you may well find that the program can only really be understood by its original writer. Since he is unlikely to be readily available when you want him this is a serious disadvantage. Look closely at the way it is produced. If it is badly laid out with corrections added, this is probably an indication that the program is written in a similar way and therefore best avoided. You should ideally be able to load the program in the machine and produce invoices without any help merely by following the instructions.

- Error proofing is even more important. The programmer must assume his precious program is to be used by malicious saboteurs. He must cater for every ridiculous path they attempt to follow and allow them every opportunity to enter wrong answer after wrong answer. If they insist on mounting the disc upside down, or forgetting to switch on the printer the program must patiently lead them back to safer ways and preserve the files safe from erroneous updates. As every programmer knows this error proofing can take twice

as long as writing the original program — so some cheap and nasty programs omit it, with disastrous results.

Test thoroughly

Having entered an invoice be adventurous. If the program presents you with a list of options and asks you for a number between 1 and 4 enter 5 and see what happens. Does it collapse with an incomprehensible error message or fall into an endless loop? It should of course ask you patiently to try again. If it asks you for a customer number and you know there are only 100 customers on file enter 120 and see if it ends ignominiously with FILE ERROR. Much better that you discover the weaknesses now than several months later in your own office faced with a pile of invoices you wish to raise.

If you are happy that the package is tough and well documented it has passed two major tests.

Now ask a few questions.

If the program needs modifying to suit some special requirements of your own, who will do this? And what if you discover an error in the program despite your rigorous tests? Have you any guarantee that it will be put right or is the package sold as is? If there are any improvements that are to be made will you receive them automatically or is there a charge for all updates?

The more expensive packages may well include some in-house support whereby someone helps you install the package in your own office. This can be a major benefit but make sure this assistance is being given as well as (not in place of) documentation. Also make sure the programmer is not merely finishing off the program writing on your premises!

A final word on packages make sure that the writer has adequately covered the question of security. You *must* take copies of your files regularly and if this proves tedious to do it will no doubt be neglected.

To summarise

1 Consider a computer for an application in your company. Concentrate on that for the moment. (Of course you should check that the computer can handle later the other applications you are interested in. But get your priorities clear first.)

2 Do not be diverted by attractive hardware. Ask about the software available.

3 Assess a package by trying it yourself.

4 Look carefully at the standard of the documentation.

5 Test for signs of error proofing.

6 Check for program maintenance. Every system has faults lurking somewhere!

If you are lucky enough to find a package that passes all the above tests, your choice of system may be more than half decided for you. If not you may consider having some software written for you. How to do this will be discussed in the next article.

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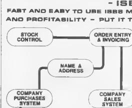

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SOME MICROCOMPUTER USES IN PSYCHOLOGY

Psychology has fought a long and not entirely successful battle to lose its popular image of psychiatrist's couches and sexually obsessed Viennese accented eccentrics. A recent ally in this battle has been the computer. Some time ago a senior Belfast University don was heard to state that "Psychology is very scientific — they even have their own computer." How much *more* scientific would he think we are these days with our three Data General NOVA minicomputers, three PETs, two South West Tech MP6800s, Alpha Micro AM-100 system, APPLE, SORCERER, Motorola D2 and an RCA Cosmac VIP? We are in no way exceptional, as almost all of the nearly 100 'psychology based' departments and research units in Great Britain have their own local computer facilities. Many of these are far more powerful than ours and some departments have whole student laboratories filled with machines such as the PET.

Why should psychologists use computers at all?

Psychology is the science which studies human and animal behaviour and forms a borderline between the social and biological sciences. As social scientists, psychologists collect large amounts of survey-type data using questionnaires and interviews. Such data is normally processed on large central computers using packaged programs. As biological scientists they attempt to model or simulate complex processes involved in behaviour and again large central machines are frequently used. It is in the area of *experimentation* — the process control of behaviour — that mini and microcomputers find such widespread use.

Outside psychology, process control might involve using a computer directly to control a factory production line, a power station or more interestingly a brewery. This involves sensing and control of real events in the world — the temperature of a vat of chemicals, progress of a component down a line, or changing the state of a control valve. Such events nearly always have to be controlled in real time, often within milliseconds, or disaster may befall both the process and any surrounding humans.

For the psychologist the 'process' is his experiment with a human or animal. Test materials (called 'stimuli') are presented to the person being tested (called 'the subject') and the actions (called 'responses') of the subject measured and recorded. Often the stimuli must be presented for precisely controlled times and the time to respond or duration of the responses accurately measured, often to within a millisecond. Many stimuli can be quite complex and need sophisticated equipment to produce and present them. Also, because people can differ so much in their reactions, it is often necessary to make many repeated tests. This is time consuming for a human experimenter but easy for a computer. It is also possible for a human experimenter unwittingly to influence the behaviour of those being tested and so introduce errors into test results. An impersonal computer avoids such biases and in fact many subjects prefer to be tested by the machine!

While forced to use expensive minicomputers to automate their laboratories, many psychologist have attempted to time-share several experiments simultaneously on one computer. They have also developed many different special purpose languages to ease the task of solving special problems or supposedly to reflect the way the experimenter thinks about his problem. The advent of microcomputers a few years ago meant it was no longer necessary to time-share experiments — one microcomputer could manage a single experiment and, if more experiments were to be run, another microcomputer was purchased.

Microcomputers have also meant that a much wider range of problems can be solved by computer; for example, the machine can be taken to test children in schools rather than trying to persuade the children to come to the laboratory. A more negative aspect is that researchers have been forced to program in assembler code or to attempt to use the ubiquitous BASIC interpreters available on almost all micro systems.

Photo 0. David Hale and his 'children' from L to R MP68 AC30 and relay 110 beneath MIME VDU, APPLE, diskette drive, Hitachi and Sony tv, Sorcerer with Sony tv, PET.

Psychology

Simple reaction time

Many of the tests used by psychologists are like games. There used to be a familiar game in pubs, before they were flooded with microprocessor-controlled TV games, which tested the time to respond to a simple event — usually a light sound. It took your money, waited a variable time, turned on a light, then timed a simple response — usually the press of a button. If the reaction time was slow, enough drink had been taken and driving certainly should not be attempted. If the time was fast you could carry on tanking up and then try driving!

When a psychologist uses this task — called simple reaction time — very precise control is needed over the duration of a warning signal and the length of the waiting period. The reaction time itself needs to be measured to the nearest millisecond. We wanted to program this test on a microcomputer for use in a student teaching laboratory. The obvious approach would be to use assembler code and perform timing using closed loops of known duration. However, we wanted to develop such a program quickly, be able to modify it easily, and wished the program itself to have some educative value. We couldn't really expect psychology students to learn assembler code but even they might pick up a little BASIC. Today there are very few BASICs with process control extensions. There is X-Y BASIC for the 8080 marketed by Lifeboat Associates at the high price of 300 dollars. While X-Y BASIC allows good manipulation of events it still does its timing by closed loops. Other real time BASICs by Mountain Hardware or Ohio Scientific, really designed for home control, are best at time of-day timing with a resolution of seconds rather than milliseconds.

[illegible] Video-taping children's social interactions in experimental caravan for later replay and analysis using PET

Our interest in microcomputers started in May 1977 after a visit to the now rather quaintly titled Build Your Own Computer meeting. The only freely available and reasonably priced system then was the South West Technical Products MP68. It was a pity that importers of S 100 buss systems were at that time charging the infamous one dollar equals one pound price that did such a disservice to the initial popularity of S 100 in the UK. We got the kit version of the MP68 and AC 30 audio cassette interface, intending not to save money but to give our technicians a chance to learn about microcomputers. Our experiences with these kits convinced me always to try to buy ready-built in the future! Even a single fault with a kit can mean many wasted days (we had a single bad memory chip) and anyway it is quite possible for a technician to construct such a kit and still learn almost nothing about how it actually works.

A positive aspect of the MP68 was the availability of a 6800-based process control interpreter called Control BASIC, developed by a psychologist, George Kiss of the University of Warwick, for psychologists. The language extensions offer such an elegant and insightful approach that it is worth describing them in detail — perhaps as a model for others to follow.

TABLE 1	Process input/output statements in Control BASIC (n and t represent variables in BASIC)
ON n	– turns on output bit n. If n = 0 then all 8 bits are turned on
OFF n	– turns off output bit n. If n = 0 then all 8 bits are turned off
SET n	– sets the binary equivalent of n into the 8 output bits
RESET n	– turns off the outputs corresponding to the decimal number n
FLIP n	– complements the state of output n
PULSE n t	– complements output bit n for t milliseconds
SENSE n	– inputs the state of bit n as a 0 or 1. If n = 0 then the value of the 8 bits is returned as a decimal number
AWAIT n	– waits until the state of n changes
DELAY t	– waits for t milliseconds

Control BASIC

Control BASIC performs process I/0 on an 8 bit parallel port giving 8 bits in and 8 bits out, controlled by the new BASIC statements shown in Table 1. It allows true millisecond accuracy timing via a millisecond interrupt driven clock giving counts into BASIC variables. Three variables give elapsed time in milliseconds, seconds and minutes, another pair of variables contain the time in milliseconds and seconds of the most recent process I/0 event (any statement changing the I/0 port state), while a third pair of variables give the time in milliseconds and seconds of the difference between the last I/0 event and an interrupt signal from an external event. As these timers are variables they can be easily manipulated — cleared, set to values, used in calculations — without the need for any other functions. A similar but simpler approach is used in our APPLE II millisecond clock routine described later. The interrupt event timer allows precise measurement of the elapsed time of an event even in a slow BASIC interpreter.

Using these instructions it is very easy to program the simple reaction time test as shown in Program 1. The program asks, via a terminal, for the number of trials required, then presents each trial as a warning signal (connected to bit 2) of 200 milliseconds duration, followed by a randomly chosen delay of between 1000 and 2000 milliseconds. The signal is given on bit 1 and the response time measured to an input on bit 1, then printed out in milliseconds. Obviously such a program could be coded in assembler, but only with much greater programming effort and with much less opportunity for easy modification. It could also be coded in most other BASICs but only with more tortuous and opaque code and with much less precise timing.

Program 1

```
100 INPUT "HOW MANY TRIALS?" T
110 FOR N=1 TO T
120 PULSE 2 200
130 DELAY 1000+RND (2000)
140 ON 1
150 AWAIT 1
160 Print Y'1000+z
170 NEXT N
```

Control BASIC is, of course, not perfect. It is a 16 bit integer BASIC whose limited numerical precision makes it hard to calculate statistical functions such as standard deviation. It does not have any operating system other than the resident 6800 monitor, so filing of programs and data can be slow and tedious (not helped by the over-complicated and temperamental AC-30). It also needs either a printing terminal or visual display to operate and, as such terminals will cost more than the computer, the total system cost can be quite high. What is needed is a similar language, but one working on some of the currently available terminal computers like PET or APPLE Interestingly a firm called Research Resources Limited of Welwyn Garden City is reported to be developing a PET Control BASIC and are also offering for sale a 6800 Control BASIC with language extensions amazingly similar to those developed by George Kiss Some of the limitations of the interpretive BASIC will be eliminated when a compiler version of Kiss s system is released by the instrumentation firm Behaviour Research and Development This system will offer a 16k byte resident editor/compiler with a 6800 processor on an S 100 board

Using the PET

PET's appearance in mid 1978 fulfilled the psychologist s dream of a cheap yet fairly complete computer system It was its own terminal with keyboard and display for text and graphics had built in cassette bulk storage for access to programs and data by named files It gave a well extended BASIC which was fully operational at a flick of the power switch had parallel ports for the connection of laboratory equipment and (most important) provided a useful real time clock timing in seconds, 60th of a second jiffies and (with imaginative programming) milliseconds or better With these features it is not surprising that psychologists have purchased PET in such quantities as to make it almost certainly the most popular microcomputer in psychology departments Certainly the arrival of PET in our department was a minor revelation for those colleagues who had previously thought of computers only in terms of poor jokes (like to err is human but to really mess things up you need a computer)

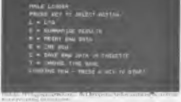
Here was a machine you could carry around take home or to a school play games against use as a super sophisticated programmable calculator and run many types of experiments Moreover it was so cheap that rather than trying to share it with others you could literally pop out to the shops and buy another computer

We have used PETs for many different experiments, including a version of the simple reaction test described earlier however just two short examples will show how the basic PET expanded only with switches on the parallel input port, can help solve vastly different problems A colleague Elizabeth Hoy was studying the social interaction of pairs of children and wished to perform a sort of 'time and motion analysis of their behaviour Unlike factory workers, children will not repeat the same activity until the observation is complete, so the behaviour is usually recorded on videotape using the portable equipment shown in Photo 1

Back in the laboratory the tape can be replayed repeatedly and notes taken on behaviour This is reasonably easy until very precise timings of activities are wanted or it is necessary to note when activities of both children occur together For example typical questions asked by the researcher might be how much of the total time are both children smiling together or when one child smiles how often does the other child gaze at the smile? PET was programmed to work as a simple time and event data logger Push buttons were connected to the parallel user port and a program recorded every change of the state of these buttons (ie when they were released as well as pressed) and the time at which this occurred All the user had to do was press a button corresponding to a particular behaviour The program had a simple menu-driven operation and gave operating displays as shown in Photo 2 From the time/history record stored in memory or on cassette tape it was relatively easy for PET to analyse whatever sequence of behavioural events was required Obviously an 8k PET with 8 input buttons cannot input and store many different codes but we can easily expand both memory and response keys by using a Forethought Products BETSI PET to S 100 adapter unit containing memory and Mullen I/0 boards

Another PET use was in a job shop scheduling problem A research student, Andy Pearce was interested in computer control of factories Eventually, factory automation will be almost completely under computer control with men monitoring the operation of the computer However in the interim stage computers can aid human control by displaying information on the state of factory production and advising the human controller as to the correctness of his decision

Job shop scheduling simply means the task of deciding which of several articles (jobs) is being worked on by which of several processes (machines) at which particular time the aim being to maximise the flow of work through a production process To do this job manually an aid called Gantt chart is often used This is simply a chart which plots either jobs or machines against time with the cells of the chart representing the machines or jobs being performed at any particular time Drawing such a chart manually involves a



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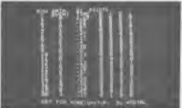

[illegible]

lot of pencil and rubber" work so PET was used as a kind of electronic note chart" to draw Gantt charts Interestingly this experiment had originally used a large NOVA minicomputer with large capacity hard disks and a Sigma Electronics QVEC refreshed graphics unit (Shown in Photo 3) Pre-prepared charts were shown to subjects who had to answer questions such as 'which job will be completed first?" or "which machine is idle for the longest time?' The results gave some idea of the best size and layout for Gantt charts but didn't put the scheduler into the real active scheduling situation PET was programmed to allow an operator to build up a chart from the keyboard and a typical display is shown in Photo 4

Photo 3 Researcher Anita [illegible] at the QVEC refreshed graphics unit connected to a NOVA mini which is running his scheduling experiment

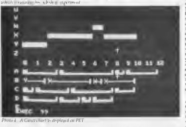

Photo 4 A Gantt chart as displayed on PET

Details of the job, machine and time are entered and then a request to insert delete, move left or right or abort is made PET updates the chart if it can and informs the operator if it cannot It also records the times taken for the various actions With such a complex task decisions take several seconds so timing to a 60th of a second is quite adequate

In most ways our PETs have been very satisfactory — we can live with the small keyboard and we even dropped one PET without obvious ill effects! We joined the head of the queue for PET printers over a year ago and are still waiting Fortunately we purchased IEEE to RS232 adapters so can make listings of programs (excluding graphics characters) on normal serial printers It is a pity, though, that these adapters are so costly — a bidirectional unit for £200 is only just under half the price of a complete 4k PET — as they turn a basically cheap system into something far more costly This was one reason for being attracted to the Exidy Sorcerer as a potentially complete system

Degraded text

Superficially the SORCERER seemed to offer the best features of other small terminal computers It had full size keyboard, would connect to a TV or monitor for 64 by 30 characters of upper and lower case text graphics and user programmable graphics had a dual cassette interface, parallel port with software drivers for a printer RS232 port 32k of built-in memory S 100 expansion box, machine code monitor, and plug in software pacs with the promise of editor/assembler and word processing pacs in the near future

Inevitably It is hard for the Sorcerer to live up to such promise! None of the problems with it are catastrophic enough to stop us being able to use the system but they do distract from its potential The keyboard is excellent with little of the keybounce apparently found on some Sorcerers but unfortunately it generates the character on the key release rather than the press Many times users have waited, lemon-like finger pressed on key waiting for a character to appear and wondering what was wrong The TV modulator on our system gives bad characters on a television which gives excellent results with other systems such as the APPLE (though the direct monitor input works well) The user-programmable graphics are unfortunately erased from memory each time the clear Screen key or character is used (obviously a bad design fault) Our machine came with a built in and apparently incurable fault on the RS232 port which is somehow disabled by the keyboard scanning firmware In order to use the RS232 interface we must load a machine code routine which will let us list BASIC programs but will not let us properly print from BASIC The annoying thing was that the suppliers delivered the machine to us knowing of this basic fault .Another Sorcerer in Belfast has a hardware 'fix with a switch to change every time a change is required between use of the cassette interface as the RS232 port The S-100 expansion box is a huge affair as large as Sorcerer itself yet containing only six slots and a power supply It comes with a very short cable so must sit right behind the Sorcerer which makes the pair too deep for some tables Add to this a lack of rigidity in the S 100 box top which makes it a poor surface to support other than small monitors plus the extra cables needed to attach cassette recorders, and you end up with a horrible jumble of units all over a work surface Just compare, for example the neat way a monitor and diskette drives fit on top of an APPLE! We in the end, made a metal one for Sorcerer which can carry a small monitor and cassette recorder (See photo 5)

There are also the well known limitations of the BASIC pac (for example no GET or proper LIST) and the lack of useful on-screen editing Finally if we were tempted to upgrade to a diskette system we would need extra memory because once the Micropolis disk operating system and BASIC are loaded into the existing 32k there is less than 8k left for the user The Micropolis disk BASIC is also extremely slow Again, just compare with a 32k PET using PET diskettes where almost all the 32k is still available for the user If all these comments sound a little jaundiced let me add that we have used the Sorcerer

Continued on p53

BRAND NEWs

ISSUE ONE

compiled by Microspy

This middle section may either be pulled out or photocopied then filed for reference It will be comprehensive and range over the whole field of products services events and courses *PU* stands for Personal User *SB* stands for small base — that is small budget or small business *MB* — medium base medium budget or medium business *BB* — big base big budget or big business

Systems

ALMARC DATA SYSTEMS Vector Graphic specialist
Five systems 1) *System MZ* Z80 processor, 4 MHz 48K RAM Disc 630K bytes 1 × serial port 2 × parallel ports — S100 bus. Disc operating system (Micropolis) Basic interpreter 2) *System B* As 1 plus terminal (dumb), graphics board 24 × 80 resolution North Star compatible Disk operating system CP/M (tm) Almarc-tailored 3) *System BG* with FORTRAN 80 (compiler) hardwired floating point board (Advanced Micro Devices chip) FORTRAN interface software 5) *System* BFG as BF includes advanced graphics package Prices £2300 (MZ) £2950 (B), £3240 (BG) £3595) (BF) £4190 (BFG) Software range CP/M (Operating System) compatible SB

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COMMODORE Full PET range See Brand News issue 2

DIGICO CONSORT Systems 16 bit processor 16 or 32K byte semi conductor Store access 360 nanosecs Addressing direct to 8K page indirect any byte up to 64K Indexed byte handling Control panel 6 digit display status indicators 16 key entry console among other features I/O Transfer rate 3M bits/sec DMA Transfer rate over 16M bits/Sec Options include additional memory to 64K Hardware floating point *Real time* clock Software Assembler Extended Basic compiler mathchart & Labchart interpreter Test Utility programs *Model 10* 16K single floppy educational & industrial *Model 20* 48K two floppy disk drives commercial Diskette Storage Starting at 345K Bytes Vendor states DIGICO Consort is ideal for first time user with a low budget Design Award Winner *SB MB*

Digital Equipment Corporation
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EQUINOX COMPUTER SYSTEMS
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G W COMPUTERS LTD
See Applications

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JACOBS COMPUTER SYSTEMS
See BRAND NEWS Issue 2

LOGITEK See BRAND NEWS Issue 2

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DEC System

BRAND NEWs

additional monitor £5500 (£137.50 pm lease) SB MB **(Alpha Micro, Cromemco, Horizon)**

MICRO CENTRE
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MICROSOLVE Apple 11, Microstar and Alpha Micro systems. See BRAND NEWS, Issue 2

Z2H from MicroCentre

Wordsmith Video System

NASCOM Models 1 and 2.
NASCOM 1 Processor Z80 4MHz/clock Memory 4K relocatable Storage cassette Teletype linkable I/O Ports internal/external 16 full handshake logic & programmable interrupt Card 12" x 8" CPU busses carried to edge connectors for future expansion 3 Amp power supply optional 8 Amp for expansion Fully documented Kit needing TV and power supply **NASCOM 2** Processor Z80 4MHZ & 2MHZ Memory onboard 20K inc 1K video RAM 2K monitor 8K Microsoft BASIC 8K static RAM/EPROM Licon hi quality keyboard 57 keys IBM layout style I/O onboard UART serial data handing for RS232/20MA teletype interface and cassette (Kansas City 300 1200 baud) PIO onboard gives 16 programmable lines Full documentation Newsletter Extensive personel user software Power supply 3 Amp optional extra *PU SB*

OLIVETTI
New Desktop IGS 60 system — Interactive Graphic system based on P6060 personal minicomputer Software includes 3 dimensional projection system 2 dimensional interactive package mathematical and statistical routines For computer aided design and analysis *MB*

PRIME
Twin PRIME 550 systems linked into its interprocessor software PRIMENET Ordered by Plymouth Polytechnic System will initially support 64 multi-access users possible expansion to 86 over two years For engineering and science PRIME s 32nd order from the world of higher education
SYSTEM Configuration 1M Byte memory 4 × 300 M Byte disc drives 2 × MT60 high density magnetic tapes and controllers papertape readers and punches *MB BB*

ROSTRONICS New Z Plus Dual Microfloppy System
Processor Z80 4MHZ clock memory 64K Standard Storage *Dual* 8in Floppy Disk Drives 509K/Diskette Total 1019K Bytes DS1930 Terminal full functioned (Cursor controls address field positioning clear screen & home cursor Erase data to end of line or end of page) 8 operating modes in character block blinking editing modes I/O Ports Serial 2 input 2 output RS232C or current loop interface Parallel 2 input output bidirectional handshake interface Mother board 10 slots 5 available for expansion Built in power supply Keyboard datachettle 11 key numeric pad CP/M (t/m) disk operating system High level languages and applications packages £3750 plus VAT 6 month warranty extendable for further year *SB*

U-MICROCOMPUTERS
Ohio Scientific CHALLENGER C3C System 29 M Byte (Winchester Technology) Hard Disc System Uses Shugart s SA 48000 disk drive Expansion to 4 users multiprogram Multitask modes *MB BB*

TANDY Full Tandy TRS80 range See BRAND NEWS Issue 2

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Applications

FILETAB SUPPORT SERVICES
Has supplied the Royal Automobile Club with its RPL 11 for the development of systems to be operated by the RAC regular staff easily Systems written are A membership file maintenance suite membership renewal Sales Ledger billing for club restaurant customers stock reporting on wines spirits and tobacco nominal and purchase ledger work processing standard letters *MB BB*

COMPUTER TECHNOLOGY LTD
Has received a grant through the Department of Industry software for *Inventory* and *Production Control* The grant is 25% of the overall cost and the development is for the small/medium manufacturer The software is expected to be ready within the next twelve months *MB*

G W COMPUTERS LTD
Integrated 32K 40K Business Systems with complete business program package Package purchasable separately Can deal with 4 companies 4 Bank Accounts 50 Agents 999 Customers/Suppliers 1000 Stock items 200 employees depending on disk storage and customer requirements Thirty one programs invoice file sales information accounts received prints sales invoices and credits right through to (in preparation) year s audit profit/loss account, projections and budgets weekly payroll and taxation *SB*

GAMMA
Has announced STOCKNET for the control of stock held in a distributed network of national regional and branch centres Transactions handled in batched form at a central site or via remote VDU located in branch outlets or a combination of the two Stocknet primarily for medium sized organisations can lend itself to large scale companies It s highly interactive Using menus help messages and prompting Standard documents screened in actual format Batch jobs automatically checked Security strong point with pass words and location codes at log in menu and job level Data corruption avoided through automatic protection Also provides hard copy records exception information Other features Outstanding order reports suggested order report financial stock account, standard cost variance report supplier Invoice cost allocation report Based on the DEC PDP/11 range *MB BB (DEC)*

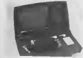
MICROMEDIA
Mailing lists Data base Management Accounts Stock Simplex linear programming word processing PERT (Critical Path Analysis) Packages only some of range Vendor Claims Wales leading System House See Systems *SB MB*

Operating Systems

CP/M (tm)
Is a general purpose operating system for 8080 or Z80 systems Its basic facilities include dynamic file management fast assembler general-purpose text editor debugger Other software packages are a macro assembler symbolic debugger text formatter spooler *The Basic Disc Operating System* BDOS) gives disc mangement by controlling one or more disc drives containing independent file directories Implements disc allocation strategies System calls enable an application program to Create Rename Delete Read and Write Files on any active media with both sequential and Relative record access to data CP/M(2 10) enables 16 logical drives of up to 8m Bytes each to be defined *The Console Command Processor* (CCP) interacts with the user through built in commands Allows CP/M System programs and user programs to be loaded in as 1 single commands *The Peripheral Interchange Processor* allows file transfer between devices and disk files as well as reformatting and concatenation *CP/M Text Editor* (ED) allows creation modification of ASC11 files CP/M ASM (Assembler) operating system needs minimum 16K RAM contiguous from location zero Other versions of CP/M will be dealt with in future issues See Equinox Rostronics Bytronix *PU SB MB*

Terminals: Display

AUTOMATION AND TECHNICAL SERVICES LTD
VITEL 11 telegraph compatible Visual Display Terminal 8080 Intel microprocessor incorporated Full range of editing control and interface functions Works in both 5 & 8 level code Baudot or new ASC11 message switching systems Dual input and output ports for connection to paper tape and hardcopy peripherals Increased storage to 2K Bytes buffer increasable in chunks of 4K to 48K Storage for stored standard instruction and phrases is up from 256 characters to 1K Software programmed capabilities include polling word processing Vendor states Large user base of over 400 mark 1 Vitels we have doubled production capability for Vitel 11 Price £2400 *MB BB*



BURR BROWN INTERNATIONAL TM25 hand held Terminal
Can also be mounted in the control console of a process controller or business system or in a vehicle 8 digit numeric dispaly numeric or hex keyboard 7 function lights 7 function keys clear and enter keys Standard CC1TTV24 & 20 MA Current loop interfaces 25 way connector 15V power supply necessary ASC11 characters transmitted at 110 or 300 baud *OEMS SB MB*

COMPUTER WORKSHOP CT82 INTELLIGENT TERMINAL
6802 processor 6845 video controller circuit 16 or 20 line screen format 82 characters per line Upper and lower case 7 × 12 dot matrix Green anti glare phosphor Limited resolution graphics set 184 × 66 pixels Own internal editing function insertions deletion of lines and characters scrolls etc Transmits to computer in blocks or to printer Baud rate programmable from 50 to 38 400 changeable by software command Standard cursor functions Protected fields shift inversion dual intensity 58 key alphanumeric and 12 key cursor pad (optional alternative numeric pad) RS232 interface and standard DB25 connectors see Systems *SB MB*

DATA DESIGN TECHNIQUES LTD
TELEVIDEO TV1 912 Intelligent VDU Industry compatible *Lear Siegler* Compatible code 24 lines × 80 CHS 7 × 10 dot matrix 12 × 10 resolution characters 12in Diagonal Screen Character Set 96 ASC11 displayable Cursor Control (9 functions) RS232C and 20MA current loop interface Transmission rate to 19200 Baud swich selectable Full duplex half duplex 10 or 11 bit word mode Parity odd even mark or space swich selectable 20 Remote commands Conversation mode 5 Protect mode 8 Addressable Cursor Scroll mode when display unprotected 105 keys 14 numeric keypad 16 special function keys 8 editing function keys

DATATYPE VISUAL DISPLAY UNITS Model DT2
Upper and lower case Numeric Pad 12 × 10 character resolution 24 × 8 character display non glare reverse video programmable underline and blinking caps lock key line and character insert/delete function keys inbuilt character insert delete line insert erase page erase send line send page page new line Vendor states Low cost expected to have considerable impact on DUMB TERMINAL Market *SB OEMS*

GTS LEAR-SIEGLER ADM3A DUMB TERMINAL
12 inch CRT display of 1920 characters × 24 rows Standard 59 keys optional 10 key numeric pad Full or half duplex Work format is selectable Transmit and receive speeds in range 75 — 19200 baud Optional graphics capability *SB MB OEMS*

HAZELTINE LTD MODEL 1552
Dec VT 52 compatible
128ASC11 Codes 95 displayable characters inc lower case 31 graphics symbols 7 × 10 Dot Matrix ANSI typwriter layout Cursor control function keys Key pad mode Integral numeric Key pad Hold screen Graphics Dual Intensity Cursor addressing spacing E1A & 2MA Interface Baud rates to 9600 Auxiliary E1A output Remote editing commands Standard or reverse Video Programmable keyswitch auto feedback 80 chs line 24 lines 1920 characters on screen Full or half duplex — 50 frames/sec refresh rate *MB BB* (DEC)

MODEL 1480 128 ASC11 94 displayable chs 5 × 8 dot matrix Typewriter keyboard 15 numeric pad User defined Hi/Lo density blink non display Cursor addressing and sensing Up to 9600 baud transmission 12 operator function keys Self test Full or half duplex E1A RS 232C connector Parity Odd Even 1 or 0 options include RS232 compatible 1/0 interface *SB*

MIDLECTRON LTD TV1912 INTELLIGENT VDU
PERICOM 6800 Range of VDUs **6801** Conversation/editing 80 × 24 characters upper and lower case 15in screen green phosphor antiglare bonded faceplate **6802** As 6801 plus 24 programmable keys **6803** Printer compatible 132 column switchable to 80 other features as in 6800 series **6804** 132 columns as 6803 plus 24 programmable function keys *SB MB*

TEKTRONIX Graphics.
See BRAND NEWS in Issue 2

TERMINAL DISPLAY SYSTEMS LTD
ADDS DISPLAY TERMINAL Regent 100/VT emulates DEC VT52 Memory size 24 lines × 80 characters 96 displayable ASC11 codes 8 × 8 dot matrix 33 special symbols + 11 special graphics symbols Blinking at 2 frames/sec/underline reverse video half and zero intensity 25th line reserved as status line Screen 12in diagonal Refresh 50 frames/second Operating mode conversational character at a time transmission Full duplx Interface EIA 232C/CC1TT V 24 or 20 MA current loop Parity even odd marking or spacing Switch selectable Keyboard standard plus 14 key numeric key pad Addressable cursor 9 Preprogrammed function keys Vendor claims more operational flexibility elaborate visual highlighting crisp well defined characters *MB OEMS* (DEC)
COLOUR DISPLAY TERMINAL Ramtek 6000A Serial asynchronous RS232C and CC1TT/V24 Data rate 110 300 4 selectable (1200 Baud default) external switch 50

9600 baud internal switch — operation above 1200 baud may require nulls or handshake 2 peripheral ports Video Outputs Special TCS Software Control nearly 90 commands

Graphics Origin (O O) Lower left corners 512 (X) × 256 displayable pixels 128 displayable ASC11 characters Colour Prom — 8 colours

Alphanumerics Format 72 cols × 25 lines 95 displayable ASC11 characters Cursor underline selectable blink Colour Prom Green default mode 8 colour primary table reverse background blink and underline display modes Edit mode Overstrike replaces with last colour and character Vendor claims Colourgraphics terminals let you develop your colour software without costly CPU overheads *MB BB RE*

Terminals: Printers

CENTRONICS — New Matrix printers

Model 730 Three way paper handling 7 × 7 dot matrix free flight head technology Upper and lower case full character set 80 col line length Undirectional at 100 cps Full line buffer Mobius loop ribbon for long life SB

BRAND NEWs

PC Retails at £650 plus *MODEL 753* Tractor paper feed Proportional and monospacing 130 150 cps with 15 cps slow rate N × 9 dot matrix twice as dense as traditional matrix Four configurations of this model all sharing a 13 2 inch print line paper out indicator self contained print test capability Vendor claims Four to five times more through put than most daisy wheel printers and Line

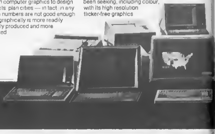
Centronics 753

Instant information and easy to

An ever growing number of users in science industry, business management and the public services now depend on computer graphics to design products, control budgets plan cities — in fact in any application where mere numbers are not good enough

Anything expressed graphically is more readily understood more rapidly produced and more effectively communicated

As the world leader in computer graphics technology Tektronix can give you the extra dimensions you have been seeking, including colour, with its high resolution flicker-free graphics



Centronics 730

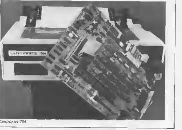
justification highly praised by *word processor users* *SB*

704 CENTRONICS

704 For data communication environments 70 400 lines/minute RS 232C/V24 serial interface 3 operator selectable protocols Data rate up to 9600 baud switch selectable Standard 256 character buffer optional extra 2K page buffer plus features shared with Centronics 700 series *MB*

DATA PRODUCTS LTD
LINE PRINTERS

B 300 steel band print font carrier giving 300 lines/minute Microprocessor based routines indicate status perform diagnostics Vendor claims Designed to give the smaller user the same high quality as large system manufacturers *B 600* as above but higher speed of 600 lines/min MATRIX PRINTER Serial impact *M200* 200 lines/min (average) bidirectional look ahead logic (micro controlled) *PU SB* THERMAL MATRIX PRINTER *T80* 80 characters/sec 80 cols format Vendor claims Printing speed approx 3 times faster than conventional thermal



Centronics 704

n...that's easy to obtain
o understand

ology,
ave

terminals, desk-top graphic computers and complete interactive design systems, all fully supported by peripheral devices, proven software and wide ranging sales and service facilities

Thinking about Graphics? — **then talk to Tektronix.** If you would like to know more why not ask your Tektronix Sales Executive, phone or write, we'll be pleased to help you

Tektronix

Tektronix UK Ltd PO Box 69 Coldharbour Lane Harpenden
Herts AL5 4UP Tel Harpenden 63141

printers Can be used as PLOTTER with graphics option DAISY WHEEL PRINTER *D50* — Has both receive only terminal and keyboard serial receive Average 50 characters/sec *SB MB* LINE PRINTER 2290 High speed 900 lines/min *MB*

DECISION DATA
SERIAL PRINTER together with a multi purpose card punch unit in compact integral package Printer 6541 02 150 cps bi-directional Serial Microprocessor controlled 9× 7 dot matrix characters upper & lower case Variable tractors 2K buffer Card Punch Unit — The 8010 111 On Line can read or punch and interpret from the system Off Line fully buffered card punch verifier and interpreter can also reproduce and collate *MB BB (IBM)*

GTS
Lear Siegler Matrix 300 series BALLISTIC Printer Bidirectional 180 cps 186 cols 136 chs/line 10chs/inch Tabs over spaces and blank character strings at 50 inches/second Serial data buffer 512 characters expandable to 21048 characters for quick dumps of full 1920 crt screens Ballistic print head matrix Built in microprocessor allows programmable font and forms control space and blank character compression interface control for serial parallel or polling and addressing operation *SB MB OEMS*

LEEWAY DATA PRODUCTS
Exclusively imports the Printerm/879 range of Matrix printers 80 cols (10 CPI) or 132 cols (16 CPI) per 8½ inch page Single and double width characters upper and lower case for all 95 US ASC11 variable forms Lengths control and top of form Software controlled 9 × 7 matrix, bidirectional logic seeking printhead motion Selectable communications rates from 300-9600 baud RS232C standard interface Options available for Centronics parallel and PET IEEE interfaces *Cheaper version* Printerm Friction Feed Printer for applications (data logging copy out from a VDU) where software programmable functions and print quality is not vital *PU SB OEMS (PET)*

MIDLECTRON LTD LA 120
DECWRITER 111
45 standard features including choice of formatting and communication 180 cps bidirectional high speed skip User can print compressed font 217 cols at 16.5 characters per inch Double width characters printable Variable spacing between lines Permanently stored format for a computer printout retrievable at any time *MB BB* (DEC)

LA120 Decwriter III

BRAND NEWs

ULTRONIC DATA SYSTEMS
UDS Ricoh RP1600 Double DAISY WHEEL 60 cps Standard clip on daisy wheel has 124 characters 5 type styles Tabulation and carriage return speed 300 MSEC for 13.6 inches Current tractor feed form Parallel interface available now RS232C in first quarter of 1980 *Qume* and *Diablo* compatible interfaces also computer compatible interface similar to that for Matrix printers Vendor states Printer gives word processing quality *OEMS* (retail at less than £800 for 100 or more orders) *SB*

Desicaion Data 3240 KR DOT MATRIX (9 × 7) PRINTER Microprocessor controlled Bi directional 165 cps Variable text and format Full plotting capability Horizontal and vertical tabs skipping over unused spaces Switchable baudrates to 1200 baud ASC11 Kbd N key rollover to minimise key depression errors independent shift and control function keys 13 Key numeric key pad Operator functions include self test local transmit mode override hold auto answer vertical position space and form feed *SB MB OEMS*

WESTREX COMPANY LTD
TALLY DOT MATRIX PRINTER.
T1612 160 characters/sec bidirectional Vertical slew 8.5 inches/sec 132 cols (programmable to 80 col) 96 character set USASC11 10 12 and 16½ cpi Standard double width character Sprocket feed adjustable Paper out audio alarm Continuous fanfold paper 3000 9600 baud parity protection Vendor claims loaded with features and functions simple for anyone to master Over 40 programmable functions *SB MB OEMS*

Bureaus, Consultancies, Services, Shops

ADDA See BRAND NEWs Issue

DATRON of Sheffield
agents for ITT2020 (Apple 11), appointed as dealers for Cromemco range the System 3 and the Z2H Mbyte hard Disk System Datron also offer a full range of books peripherals software specialist calculators Ian Dunkley Managing Director says that Datron's own business operation will increasingly come to rely on the Cromemco and that as a small business itself it is in a good position to realise small business needs The Centre a spin-off from the parent constructional project company will pay great attention to construction industry needs *SB MB*

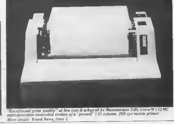
DISCON Air conditioning systems for computer rooms
Full design installation and maintenance Controlled environment specialist, turnkey systems Vendor states 'give a computer the wrong environment and it will withdraw its labour *MB BB*

DISTRICT COMPUTING
Computing Services to small users
Accounts stock, mailing implemented on Diablo systems See article in Issue 2 of *Computer Age SB*

BARIC Comprehensive Bureau service See Article in this issue (Issue 1) *MB BB*

A. J HARDING (MOLIMERX) Software for TRS80 microcomputer See Literature

GAMMA Engineering Services Division TURNKEY PLUS Service Complete Computer room installation — installation maintenance of DEC equipment Communications Cables Patch Panels Speed up modifications *MB BB* (DEC)


"Exceptional print quality" at low cost is achieved by Mannesmann Tally's new M 132 MC microprocessor controlled version of a "proven" 132 column 200 cps matrix printer More details Brand News, *Issue 2.*

IBM New remote computing service CALL-VSPC (CALL Virtual Storage Personal computing) based on its Warwick computer centre The service claims a number of new interactive computing facilities including the availability of the two interactive programming languages AS (applications systems) and VS APL

FEATURES OF CALL-VSPC Processing in both batch and interactive mode 2) The Text formatting interactive SCRIPT/VS system with output at the Warwick centre or on the user's own terminal 3) Access to OECD databases containing economic trend information *SB*

ICL DATASKIL
Software implementation on a very wide range of micros See BRAND NEWS, issue 2

LOGIC BOX
Newly formed shop concentrates on complete Commodore and Hewlett Packard products Associated with Beyts Logic (Principals of Logic Box are George Spelling and Jock Eggeling) They claim to fully support their customers because both hardware and software is available with maintenance and advice Shop is backed by entrepreneur and city industrialist Nick Leonard so there is no problem with under capitalisation *SB* (PET Hewlett Packard)

Jock Eggeling and Tim Beyts celebrate the opening of the Logic Box

Literature

MINE OF INFORMATION BOOKS Company has expanded booklist by 50% Sails to institutions ⅓ to Technological companies mostly those with previous experience in electronics and now into micros Remainder of sales are to range of people with a personal interest *Richard Ross Langley* Principal of company recommends the following books in the range The Mighty Micro by Christopher Evans Basic Concepts Vol 1 by Adam Osborne Illustrating Basic by Donald Alcock *PU SB*

COMART Catalogue Contains list of distributors Sets out details of distributors products Horizon — Cromemco IMI 7710 Hard Disk Interface boards and other products comprehensive price list *SB MB OEMS*

INTEL
Bubble Memory Design Handbook for engineers 7710 1Mbit Bubble Memory Operation and performance of the 7110 and its supporting chip set is described in detail *OEMS*

BRAND NEWs

Jock Eggeling and George Spilling of the New Micro Store Logic Box

NASHUA
Useful information guide for DEC Computer Drives and Nashua Disc Packs and Cartridges Gist of guide is that bad sectors when formatting need not be bad sectors at all the guide explains why Nashua states that it certifies every disc pack and cartridge it sells for use on DEC System *MB BB (DEC)*

A. J HARDING (MOLIMERX)
Microcomputer Software Catalogue comes in a ring binder for easy addition or removal of information that vendor — a TRS80 specialist — sends Full of inside news hints products and applications for the TRS80 Includes details of BASIC 1 11 111 and infinite BASIC 3 0 DOS G2 Level 111 BASIC Very useful compendium for TRS80 users *SB* (TANDY)

PETSOFT A photography course learning module interactively uses PET's graphic facilities The theory and practice of photography are examined in eight 7K segments ranges from How the eye sees lenses Camera Types to Miniature cameras and flash exposures On cassette £12 plus VAT Disk version planned at £15 00

STRUMECH ENGINEERING ELECTRONIC DEVELOPMENTS LTD , (SEED)
Catalogue gives clear full detail of SEED systems products Full systems to components for OEMS *SB MB OEMS* (MSI6800) See Systems

Specialist magazines
& Newsletters

PRINTOUT is for PET Users Edited by ex-Commodore man Richard Pawson takes independent look at hardware and software riding on the back of PET Includes program listings hints applications a gossip column £9 50 for ten issues (U K.) £14 50 overseas from PRINTOUT Greenacre House North Street Theale Berkshire RG7 5EX Tel 0753 20814 *PU SB (PET)*

Liverpool Software Gazette
Published bi-monthly by *Microdigital* 25 Brunswick St Liverpool L2 OPJ Tel 051 227-2535 Aim is to try and give as much information as possible to the micro computer user mostly machine-specific for users of personal systems Cover prices is 50p 12 issues for £6 00 *SB*

SWURCC NEWSLETTER
Issued by the University of Bath Claverton Down Bath BA2 7AY TEL (0225) 84351 Deals with the 2980 and South West Universities Computer Network No price on newsletter *LB*

EXHIBITIONS — COURSES — EVENTS

One day courses in house for members of the Institute of Chartered Accounts arranged by that body It is for all levels of computer staff involved with computer based accountancy Details from Chartered Accountants Hall Moorgate Place London EC2R 6EO Tel 01 628 7060

DATRON OF SHEFFIELD
Are planning Seminars for businessmen at their Datron Micro Centre Details to come

COMMODORE
Training Courses — Mike Grose Nicklaus Training Manager of Commodore organises One PET to every 2 students *Primary BASIC Course* fundamental skills *Disk Utilisation Course* System designers BASIC users file organisation efficient implementation *Dec 3 5* Primary Basic Venue Glasgow *Dec 6 7* Disk Utilisation Venue Glasgow *Dec 18 21 Primary Basic Venue Coventry* Accomodation available *Fees Primary £225 (accomodation) £175 (basic) Disk Utilisation £125 (accom) £100 (basic) (PET)*

INTEL Microprocessor
Workshop Course
2-4 days long Intel range of microcomputers Individual attention good proportion of hands on training *Dec 3-5* Introduction *Dec 10 13* **MCS** *48 micro Dec 17 20* MCS 85 micro

Address Bus

Almarc Data Systems
29 Chesterfield Drive Burton Joyce
Nottingham Tel-0602 248585

Automation and Technical Services Ltd
Bridge Road
Haywards Heath
Sussex, RH16 1TY Tel 5864-52377

Baric Computing Services Ltd
Forest Road
Feltham, Middx Tel 01 890-1414

British Olivetti
30 Berkeley Square
London W 1 Tel-01 629-8807

Bytronix
83 West Street
Farnham Surrey

Commodore
818 Leigh Road
Slough
Berks Tel 75 74111
(Commodore Dealers all over UK)

Complete Microsystems Ltd
See Microcentre

Computer Technology Ltd
Eaton Road
Hemel Hempstead
Herts
Tlx 825052 Tel 0442 3272

Computer Workshop
28 Dover Street
London W1 Tel 01 491 7507

CPU Peripherals
Copse Road
St Johns
Woking Tel 04862 73883

Centronics Data Corporation
Victoria Way
Burgess Hill
Sussex Tel 04446-45011

Comart
P O Box 2
St Neots
Huntingdon
Cambridgeshire
PE19 4NY Tel 0480-215005

Data Efficiency Ltd
Maxted Road
MaylandsAvenue
Hemel Hempstead
Herts HP2 7LE
Tlx 49280 Tel 01 207 1717

Data & Research Services Ltd
18 Burners Lane
Kiln Farm Industrial Estate
Milton Keynes Tel 0908-567114

Dataproducts Ltd
Tel 0734-585723

Datron Micro Centre
Latham House
243 London Road
Sheffield Tel 0742 585490

Decision Data Computer (GB) Ltd
Corrie House
48-54 London Road
Staines
Middlesex
Tlx Tel Staines 59455

Digital Equipment Co Ltd
Digital House
Kings Road
Reading Berks
Tel 0734-583555

Discon Air Conditioning Ltd
166 Main Road
Biggin Hill
Kent Tel-01 267 11781

District Computing
174 Head Road
London
S W 10 Tel-01 373-6571

Equinox Computer Systems Ltd
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26 Anning Street
New Inn Yard
London
E.C.2 Tel 01 739-2387/9 729-4460

Filetab Support Services Ltd
118 Brompton Road
London
S W 3 Tel-01 589-4986

G W Computers Ltd
(Grama/Winter)
89 Bedford court mansions
Bedford Avenue
London
W C 1 Tel-01 636-6219

GTS
22 Market place
Wokingham
Berks Tel-0734-791388

Gamma Associates Ltd
Broadway House
7/9 Shute End
Wokingham
Berks Tel 0734-20313

A. J Harding (Molimerx)
28 Collington Avenue
Bexhill on-Sea
E.Sussex Tel 0424-220391

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Terminal House
14 Petersham Road
Richmond
Surrey TW10 6UW
Tlx 928572 Tel 01 948-3111

IBM United Kingdom Ltd
P O Box 41
North Harbour
(Baltic House)
Portsmouth

ICL Dataskil
118-128 London Street
Reading Tel 0734-583696

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Chartered Accountants Hall
Moorgate House
London
E C 2 Tel 01 628-7060

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4 Between Towns Road
Cowley
Oxford
Tlx 837203 Tel 0865 771431

Interam Computer Systems Ltd
59 Moreton Street
Victoria
London S.W 1
Tlx. 928859 Tel 01 834 0261/(2733)

Lenway Data Products Ltd
Gresham House
Twickenham Road
Feltham
Middx
Tlx 27419 Tel 01 894-6611

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31 Palmer Street
Caxton Hall
London
S W 1 Tel 01 222 1122

Logitek
30 Kelvin Avenue
Hillington 2nd Est.
Glasgow
Tlx 777255 Tel 041 882 1166

Micro Centre
Complete Microsystems Ltd
132 St Stephen Street
Edinburgh Tel 031 225-2022

Microdigital
25 Brunswick Street
Liverpool Tel 051 236-0707

Micro Media (Systems)
14 Chepstow Road
Newport
Gwent Tel 59528/041691/63316

Microstore Computer Services Ltd
125-129 High Street
Edgware
Middx Tel-01 951-0216

Middlectron Ltd
King Street
Belper
Derby
Tlx. 377679 Tel-0773 82 5442/5780

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Bucks
Tlx 248507 NCS Tel 0635 30505

Newtons Laboratories
123 Wandsworth High Street
London
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121 High Street
Berkhamsted
Herts
HP4 2DJ Tel 04427 74343

Nashua Copycat Ltd
Berkshire

Olivetti
See British Olivetti

Petsoft (ACT Group)
P O Box 9
Newbury
Berks Tel 0635 201131

PRIME computer(UK) Ltd
Tel 01 572 7400

Printout
Greenacre
North Street
Theale
Berks Tel 0753 20814

Research Resources Ltd
40 Stonehills
Welwyn Garden City
Herts Tel- 96 26833

Rostronics Ltd
115-117 Wandsworth High Street
London
S W 18 4JP Tel 01 87 -4805

SEED (Strumech Engineering Electronics Developments)
Coppice Side
Brownhills
Walsall
West Midlands
Tel 05433 279-4321

Tandy Corporation
Bilston Road
Wednesbury
West Midlands
(Tandy branches all over UK)

Tektronic UK Ltd.
PO Box 69
Coldharbour Lane Harpenden Herts
Tel Herpenden 63141

Terminal Display Systems Ltd
Hillside
Whitebirk Estate
Blackburn
Lancs
Tlx 63182 TDS G Tel 0254 672214

U Microcomputers Ltd
P O Box 24
Northwich
Cheshire
CW8 1RS
Tlx 666582 Tel 0606 73390

Westrex Company Ltd
152 Coles Green Road
London NW2
Cables Westelcol Lnd NW2
Tlx 923003 Tel 01 452 54 1

Xitan
23 Cumberland
Place
Southampton
Tel 0703 38740
(Tues-Sat)

from p44

productively but, if given the choice, would prefer to interact with PET or APPLE

Our application makes use of the Sorcerer's *unique* programmable graphics characters to display degraded text Another research student Lorraine McClatchey was working on 'speech reading' which is the proper name for lip-reading (because not only the lips give the speech information) She was interested in why some readers as well as some speakers are better than others One part of her work studied speech reading tasks in which the facial information was degraded and the accuracy of reading measured She needed an analogous situation using textual material in order to discover if the people who were good with degraded speech were also good with degraded text

There are many ways to degrade text It can be made less bright, defocussed be covered by line patterns or the characters themselves can be distorted and made less readable Producing such text can be quite time consuming and it can be hard to

Psychology

quantify the actual degree of degradation Sorcerer text characters are drawn on an 8 by 8 dot matrix but because they reside in ROM cannot be modified directly However if copies are *moved up into* the RAM area normally used to hold graphics and user-programmable graphics characters they can modified This was done by complementing the state of each bit of each of the 8 bytes of each of the 26 alphabetic upper-case characters with a probability of between 0 and 0 15 that this bit would be changed The general effect is to add or remove dots from the characters and can be seen in Photo 6 Clearly with a p = 15 of change the characters are virtually unreadable Four different levels of degradation were used and BASIC takes about three minutes to produce the sets However the RAM area containing the degraded characters was loaded from cassette tape via the machine code monitor and this only took about fifteen seconds

In order to select which characters were drawn on the screen normal text was input and then each character code changed so as to point to the appropriate graphics character area in memory Text was presented to subjects a word at a time by a sort of moving window which simulates the way in which speech is read

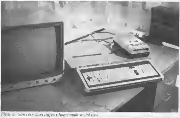

Photo 5 Sorcerer showing our home made metal case

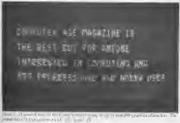

Photo 6 Degraded text on the [illegible] Sorcerer using its programmable graphics characters The probabilities of degradation are 0 [illegible] and 15

Number comparison

Until its recent large price cut the APPLE 11 always seemed a little overpriced — selling mainly on its well advertised colour display capabilities After implementing an experiment on an ITT 2020 APPLE I now feel that the less well-advertised aspects of the system are its real strength - *two* high resolution graphics pages the ability to predefine graphics shapes via a shape table and a keyboard/screen system which doesn't tie up the 6502 interrupts

Yet another research student Gerard Mulhearn, was interested in the curious inability of many children and some adults to do even simple arithmetic Because such deficiencies come from many complex causes, psychologists try to simplify the problem down to components which can be studied more easily

The most basic element of any arithmetic problem is the ability to recognise number and decide which is the bigger — to compare the digits We needed to present a digit for a precise time and then to present another digit alongside it The subject would make a decision as to which digit was the larger (numerically) and press one of two response buttons to indicate whether the left or right side digit was largest The response time would need to be accurately measured to the nearest millisecond It sounds a pretty simple problem but we have to find *both* a way to measure milliseconds and a way to draw large characters very quickly We also need to change from a display of one digit to another quickly store large numbers of stimulus digits and record large numbers of response codes and times

We used a 48kbyte ITT APPLE with single diskette drive serial interface, parallel interface made from a 6522 VIA chip, Mountain Hardware clock and a 9 inch Hitachi monitor APPLE chose itself because of its pair of high resolution graphics pages These are two 8kbyte memory areas which map onto the display to give a dot matrix disply of 320 by 196 points In theory each of these dots can be one of 4 or 8 colours but in practice only white and black are really useful As these high resolution pages need 16k total we had to have the full 48k to house the 12k disk operating system and shapes tables

APPLE will work fairly happily with a single diskette drive providing you just want to backup BASIC programs We were using the diskette only for short-term data storage before transferring results via the serial interface to a larger computer for long-term storage and analysis The 6522 Versatile Interface Adapter chip is very easily connected to the APPLE buss and, though we used a custom made board it would be easy to use the prototyping boards on offer by Microdigital By doing this and for under £30, you would have a pair of bidirectional programmable parallel ports and a pair of timer/counters which can work as interrupt timer readable timer counter of external events and even as a serial device to connect a terminal All we used it for was to connect a pair of response buttons The Mountain hardware clock is basically a 'time of day clock with on-board firmware to return date and time to BASIC programs It also generates interrupts the minimum being 0 1 millisecond (Can anyone suggest a use for such an interrupt time?) We used a millisecond interrupt to maintain a software clock, of which more later

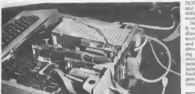

Photo 7 APPLE rear showing 25way connector panel From the left the contents of APPLE are rf modulator disk controller Mountain Hardware Clock home made VIA board and serial interface

I've never seen a published comparison of the APPLE APPLE and ITT APPLE so a few comments may be in order We got the ITT version because it was available locally 'off the shelf' with the bonus of potential local advice and support for a system which we needed to get 'on the air as quickly as possible It must be said that our local supplier (Medical and Scientific Computer Services of Lisburn near Belfast) have been models of patience over our frequently inane questions However a lot of these questions were caused by the unpublicised and unsuspected differences between APPLE and ITT!

ITT dealers are quick to mention the greater graphics resolution of their model (320 versus 250 dots wide) but do not mention the penalties one pays for this

The extra resolution is achieved by using 9 bit 'bytes' for the high resolution pages with the extra bit being switched under control of an output port (which also results in one fewer games I/0 bits) The mapping of memory to screen position is therefore different from APPLE and while most APPLE machine code software will draw on the ITT it will leave blank lines on the screen We cannot for example run the superb Software Bank demonstration programs which draw photographs of Marilyn Monroe or Winston Churchill This is cause for sadness but hardly for complaint More serious, however, is the speed penalty to be paid for the slightly higher graphics resolution where many graphics operations will take double the time

I have timed programs on both an APPLE and ITT and found, for example that the HGR instruction which clears the first high resolution page takes over 600 milliseconds on ITT but under 300 on APPLE Likewise vector plotting routines take twice as long and even drawing shapes from shape tables is 25% slower For some graphics applications these speed penalties could be most serious Another problem with the 9 bit graphics memory is the inability to use the disk operating system binary file commands directly to save or load graphics memory areas Instead one has to load a special machine code routine and call this from BASIC which wastes both space and time Another disimprovement lies in the case design Apple has a row of vertical slots at the rear of the case which allow easy attachment of 25-way connectors such as provided with the serial interface ITT s case appears to retain these slots but unfortunately they have extended the lid which makes it impossible to fasten the 25 way connectors unless as we did one manufactures a special panel and grafts it onto the rear of the cabinet (See Photo 7)

Millisecond timing was very easy to achieve because the operating system does not use interrupts (unlike PET) and also because the various pointers to areas of BASIC are well documented in the APPLESOFT manual On the subject of manuals, the DOS 3 2 manual is one of the best I have ever seen It gives information for the novice the expert user and someone just wanting a quick summary It is well written and occasionally even funny! The Mountain Hardware clock is jumpered to give an IRQ interrupt every millisecond which is vectored to a machine code routine at location Hex 300 which maintains a 16 bit counter The coding for this routine is given in Program 2 along with the setup routine which is accessed via a CALL 900 The nicety of this timer is that it counts into a BASIC integer variable making it very easy to use in BASIC All you have to do is ensure that the time variable is the very first variable defined in your program and then follow it with a CALL 900 which sets up the interrupt linkage and zeroes the clock At some great cost saving we could have easily obtained millisecond interrupts from the 6522 chip but the Mountain hardware clock does have the impressive ability on a DOS bootstrap to print the current date and time on the screen to the nearest millisecond making this APPLE one of the most expensive clocks around!

How could we draw good quality digits? It would be possible but very slow to draw them using the point or vector plot routines The number of digits required and the problems mentioned previously about saving 9-bit bytes precluded loading each digit directly from disk The answer obviously was to use shape tables which allow *predefined* high resolution shapes to be stored in a file reloaded and then drawn at any screen position rotation or size with a single command

PROGRAM 2
APPLE CLOCK ROUTINE

```
/INTERRUPT ROUTINE
300   8C  FD 03     STY   $03FD
303   A0  03        LDY   #$03
305   B1  69        LDA   ($69) Y
307   18            CLC
308   69  01        ADC   #$01
30A   91  69        STA   ($69) Y
30C   A0  02        LDY   #$02
30E   B1  69        LDA   ($69) Y
310   69  00        ADC   #$00
312   91  69        STA   ($69) Y
314   AD  C7 C0     LDA   $C0C7
317   AD  C8 C0     LDA   $C0C8
31A   AC  FD 03     LDY   $03FD
31D   A5  45        LDA   $45
31F   40            RTI

/SETUP ROUTINE
384   A9  00        LDA   #$00
386   8D  FE 03     STA   $03FE
389   A9  03        LDA   #$03
38B   8D  FF 03     STA   $03FF
38E   A9  01        LDA   #$01
390   8D  C9 C0     STA   $C0C9
393   8C  FD 03     STY   $03FD
396   A0  02        LDY   #$02
398   A9  00        LDA   #$00
39A   91  69        STA   ($69) Y
39C   C8            INY
39D   91  69        STA   ($69) Y
39F   AC  FD 03     LDY   $03FD
3A2   58            CLI
3AC   60            RTS
```

According to the APPLE manuals one can build shapes by constructing strings of coded bytes which move a high resolution spot sequentially into one of the four quadrants surrounding the current position of the spot The move can either display or not display the spot and there are tedious rules about termination and packing of bytes In practice this system is so complex as to be pretty well unusable via hand coding Fortunately software to aid the production and filing of shapes is available in the form of the 'SHAPE MAPPER' from SOFTECH of Dublin This £50 package (on diskette) draws graph paper on the screen and allows the user to drive a cursor around this paper via keyboard characters Thus it is possible to build up a shape combine shapes build shapes into a table save onto diskette and then reload into a user program

From the user's viewpoint APPLE is most convenient He powers up, presses a four key keyboard sequence and about thirty seconds later is running his application program APPLE has loaded its disk operating system displayed the current date and time on the screen loaded the timer routines loaded the shape table and then loaded and started execution of the application program I am really quite enthusiastic about APPLE but wish it were a little cheaper Its faults include fairly poor on screen editing (compared with PET), inability to input and display lower case characters easily (you can draw them with high-resolution graphics however) and the fact that its serial interface board uses firmware to serialise characters Slightly nastier is a possibility of being unable to copy diskettes when two drives are connected to the same controller, unless both drives have been very carefully synchronised Perhaps this is why most dealers tell you that diskette drives are not freely available unless you buy them with a controller!

Conclusions and the future

From this highly individual look at four different systems you will have gathered that despite some defects *all* have performed useful jobs and *all* represent incredible value for money in terms of what was available only a very few years ago Most the defects could be very easily cured and really should not have been allowed through in the first place I suppose the MP68 succeeds in terms of ultimate modularity — you just buy what you need and it is very easy to get at In its new 6809 form it seems very powerful PET is certainly the most self-contained system and given a built-in serial interface would be hard to beat Sorcerer is a *good* concept let down by poor attention to detail while APPLE is a little costly (and I do miss those Marilyn Monroe displays)

The trouble is that we now have the choice of many other newer systems Perhaps I can persuade my boss to let me buy a COMPUCOLOR ATARI, OHIO TEXAS

About the author

David Hale is Senior Lecturer in Psychology at the Queen's University of Belfast where he supervises technical and computer services and lectures on human skills and computer applications in psychology

He has used computers in research and teaching since first learning Atlas Autocode at Manchester in 1965 While doing co-operative research with ICL on the skills of keyboard data preparation operators he used 1900 FORTRAN and PLAN At the Applied Psychology Department of Aston University he began a long-term affair with small computers — starting with a DEC PDP9 and since involving PDP12 and NOVA systems

He has recently organised two successful conferences in London in association with the British Psychological Society and the Association of Psychology Technicians covering the areas of Psychological Laboratory Computing and the Uses of Microcomputers in Psychology He is currently organising another meeting scheduled for December of this year on Software for Psychological Research which is sponsored by the Social Science Research Council He has just completed a SSRC contract on Low Cost Computing in Psychology which laid particular emphasis on the use of the 'appliance' computers described in his article

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HELPING THE DISABLED

'A mentally handicapped person's brain does not develop as fast or as full as a normal person's ... he or she may behave like a small child'

Microcomputers offer many opportunities of great significance in business and administration, research and teaching

However according to Jonathan Seagrave, senior research officer at the London Borough of Hillingdon's social services department the greatest relative benefit of microcomputers must surely be the application of their analytical power to the rehabilitation of severely handicapped people into the mainstream of society

Computers have become a part of our modern lifestyle because mankind wanted better tools for solving problems and keeping records One need led first to calculating machines – the abacus, slide rule adding machine and pocket calculator The other can be traced back even further through filing cabinets to the picture writing of early civilisation

At this point many educators are still not prepared to utilise the technology of the century ahead, even when the interest has been there restrictive budgets and the complexities of large computers have had discouraging effects and influences

Where computing facilities have been made available within educational establishments interruptions of service were too frequent for most teachers to accept because of the complicated process of con

Case Study

rections over telephone lines to computer timesharing systems – the primary source of computing power until recently.

Because of their size and weight and their necessity for telephone connections computer usage could only occur in locations planned for the purpose. The learners had to be brought to the computer rather than having the computer brought into the learning environment.

Thankfully, in the case of handicapped people, the advent of microprocessor-based systems (microcomputers) is radically changing this scenario. Before dwelling on this a little further, a quick note is

needed because there is some confusion on the use of these terms.

The presence of a microprocessor in a product does not turn it into a computer. A microprocessor should at best be regarded as a crankshaft in an engine, let alone a motorcar, and in the same way, a lot of electronic circuitry is needed to produce a computer which may be used by ordinary people in the same way as they may drive cars without being mechanics.

The London Borough of Hillingdon recently bought an Apple II microcomputer from Personal Computers Ltd. The Research Section of the Social Services Department is based at the Civic Centre and headed by Jonathan Seagrave.

'Everyone knows the television bat and ball games,' says Jonathan. 'The microcomputer can produce far more varied and sophisticated versions of these which are more realistic and flexible. For example there are Moonlander Games, Star Wars and a whole range of others from Backgammon to Blackjack.

Fun though they are, these games are prepared for the educated and numerate and are mostly the byproduct of bored American computer specialists.

Beyond this, there is vast scope for developing games both attractive and developmentally helpful to the kinds of handicapped children and adults we are in business to care for,' observes Jonathan.

A mentally handicapped person's brain does not develop as fast or as fully as a normal person's, and in some respects he or she may behave like a small child.

Games can in principle be made adaptive to the player's ability, and the availability of colour graphics and music synthesisers means that a whole new area has opened up for individual expression and development. Such purpose-designed games might have an additional role in monitoring the development of certain skills such as co-ordination.

Computer assisted learning has so far been directed largely towards higher education, but we may find that its greatest value is amongst the young slower learners, particularly where the price is acceptable and where a standard television set may be used.

Jonathan describes the project taking place at the London Borough of Hillingdon Adult Training Centre and its annexe in West Drayton. Mrs Flitter, a qualified teacher, takes on a number of able trainees with the object of improving their basic academic and social skills.

She finds that the trainees are enthusiastic about using calculators and television games and she is keen to try out further ideas along these lines.

The first series of experiments takes place with a Texas Instruments 'Little Professor', a cheap calculator-like arithmetic teaching device. Trainees clearly enjoy using it, but it suffers from two disadvantages: firstly, the size of the display is very small, secondly, there are varying levels of difficulty and the lowest level produces quite a lot of zeros, for example 3+0 6+0 and so on.

'Zero is a difficult concept to grasp,' explains Jonathan, 'especially for those who, like many trainees, have to count on their fingers. We needed much more control than this could offer.' The next step was to try out the department's Apple II microcomputer. This has the advantage of displaying large numbers on a television screen, and because it is programmable the problem of the zeros can readily be resolved.

During the training sessions, each lasting about 15 minutes and normally attended by three trainees, a trainee sits in front of the Apple II computer which appears to be no more than an ordinary typewriter keyboard connected to a television set. He (or she) is shown in the photograph flanked by Alison Kiteley (Jonathan's assistant, who operates the machine) on one side, and by Tariq Malik (on the other) who is employed under a project called the Special Temporary Employment Programme (STEP) and keeps a log of the trainee's progress.

One of the programs displays a simple arithmetic addition to be solved on the television screen. Above the sum is a mountain which is climbed by a matchstick man each time a correct answer is given, so providing constant encouragement to the trainee. This and similar programs use sound effects, and successes are rewarded with a cheerful bleep. Second and third tries are permitted before the program gives the right answers and goes on to the next question.

Another game program, called Bomber, is used as a co-ordination test where bombs are released from an aircraft moving along the top of the screen by depressing one of the keys. If this is done at the right moment, the bomb falls onto a tank at the bottom of the screen, the tank explodes in a spectacular fashion.

'The result so far has been encouraging,' concludes Jonathan. 'Virtually all the trainees who tried the machine liked it and responded well to it. At first some of the trainees took some time to grasp the general idea of what the programs are intended to do, but their recall from one session to the next has been better than originally expected.

Many trainees have to count on their fingers

We are most grateful for the financial support of the Manpower Services Commission which through the STEP project has made this trial possible. It has shown not only that there are physically handicapped people available who can help to implement such projects but also that they can devise original teaching programs too.

By mobilising unemployed handicapped people, such results more than justify the modest financial resources committed to this.'

FORTH ECHO STAR

LEARNING FORTH

SLOGAN HELP!

HELLO

Series

GRAFFITO

Forth is a high level programming language designed for small computers. It has been in existence for some years and has a following in America, but is only just beginning to appear in Britain. The main advantages of FORTH are

- It requires only *a small* amount of memory
- It is *fast*
- It lends itself *naturally* to structured programming
- It is virtually *machine independent*

I propose to illustrate the use of FORTH by showing a program and what it does then discussing how it does it. The implementation I am using is APPLEFORTH V1 5 on cassette. I also have APPLEFORTH V1.2 by Programma International though I have not made much use of this version yet. Both these versions are also available on disc

A FORTH program (explanation later)

```
STAR 42 ECHO    OK
STARS 0 DO STAR LOOP    OK
PLACES 0 DO DOWN LOOP    OK
SLOGAN    FORTH RULES    OK
GRAFFITO HOME 10 PLACES
    11 SPACES 15 STARS CR
    11 SPACES STAR 13 SPACES STAR CR
    11 SPACES STAR SPACE SLOGAN SPACE CR
    11 SPACES STAR 13 SPACES STAR CR
    11 SPACES 15 STARS DOWN    OK
```

What it does

On typing GRAFFITO and hitting the RETURN key, you get.

```
* * * * * * * * * *
*                 *
*   FORTH RULES   *
*                 *
* * * * * * * * * *
                    OK
```

(The OK comes free FORTH always does it if it likes what you've done)

How is this result achieved?

FORTH is usually described as consisting of a *dictionary* of defined words which are stored in memory when the tape (or disc) is loaded I prefer to think of it as a book of Spells since when you invoke one by typing it and hitting the RETURN key something always happens

It might be something disastrous For example if you type FORGET and hit RETURN the entire dictionary in main memory is wiped out and you need to load again You can look at the dictionary words together with their addresses in memory by typing CAT Any key pressed will stop the listing

Here's what happens when I try a few out of curiousity (The word I type appears on the left and I underline the response)

WHO   BY WFR, 7/30/78   OK

(This refers to the fact that Bill Ragsdale wrote the original for this version It was subsequently extended however by John Draper)

Here's another

HELP   5 CLO   5 CSA   5 CAS   6 REC

(Actually this is just the first line of a complete listout of the dictionary)

The listout above proved very useful to me since I had very little documentation with this version It revealed the fact that although FORTH recognises only the first three letters of a word it also takes account of the word length That is the first word above is CLO** the third word is CAS***** A guess that CLO stood for CASSETTE LOAD and CSA for CASSETTE SAVE proved right The numbers in front of the words give their lengths

Now, it is obvious that a language which merely consists of a couple of hundred words (most of which are used by the system and not by the user) is not much use as it stands The power of FORTH however, lies in a small internal program which enables the user to *define his own words by linking others*

We'll first say precisely what is meant by a FORTH word A word in FORTH is any set of characters limited at each end by at least one space and containing no internal spaces HELLO is a word and so are the three words AB RA CA DAB RA ! *!)(*?

Such words mean nothing unless they either appear in the Dictionary already (for example ' does) or you have put them in the Dictionary yourself by writing definitions for them In the FORTH program above words which I have myself defined are in *boldface* to help

This brings us back to the program I started with

Let's look at the first line

STAR 42 ECHO

Here, I am defining the word **STAR**

You must start such a definition with a colon followed by a space and then the word you wish to define. All the words which then follow the defined word must *already* be in the Dictionary — that is to say they must already be in the package (permanently defined) or have been previously defined by yourself. However pure numbers need no definition at all.

Back to the first line

42 is a number (Needs no definition.)

ECHO is a FORTH word. It says that the number preceding it is to be interpreted as an ASCII character in this case * rather than as a number. (As a FORTH word ECHO comes permanently defined with the package.)

This FORTH word terminates a definition.

Thus I have defined **STAR** myself in terms of pre-defined FORTH words.

If I now type STAR and hit RETURN a Star will be printed on the screen.

The next definition I effect

```
STARS 0 DO STAR LOOP
```

enables me to type the expression 10 STARS and a row of ten stars will be printed. In this definition 0 is a number not an ASCII character. DO and LOOP are FORTH words (they come ready defined in the package) and **STAR** has been defined already, but by myself. I will leave the discussion of the Loop construction until later.

Continuing the explanation of the program

```
PLACES 0 DO DOWN LOOP
```

DOWN is a FORTH word. It moves the Cursor down one line. The rest of the words we have met already and **PLACES** is thus now defined in terms of them.

```
SLOGAN    FORTH RULES
```

is a FORTH word and anything enclosed between it and the next will be printed on the screen in just the format you choose. If I now type **SLOGAN** it causes FORTH RULESOK to appear on the screen.

We can now play about. Type in

```
3 STARS SLOGAN 3 STARS
```

and we get

```
* * * FORTH RULES *  *  * OK
```

If we precede this command by

```
10 PLACES
```

then the message will appear 10 lines down.

It is best to type HOME at the beginning because this clears the screen and puts the Cursor at the top.

Now the last line

GRAFFITO is another word I have defined. It's a longer definition with the termination word ( ) just before OK (see the program). **GRAFFITO** is almost self-explained except for the words SPACE SPACES and CR. Now these are ready defined FORTH words. CR stands for Carriage Return and SPACE and SPACES have obvious meanings.

I have not attempted to produce the slickest program for producing the above result but have chosen a form which comes close to being directly readable.

It is possible to relieve the tedium of writing 11 SPACES five times over by the definition

```
ON SPACES
```

Now ON means what SPACES meant before. Why? Because we have defined it to be.

ON and SPACES can now be used interchangeably. You can if you want from now on retain ON in the Dictionary permanently and so save time in formatting.

There is one point to bear in mind. If you redefine SPACES to mean something else, for example

```
SPACES    HOLES
```

its original definition will be lost to you since the Dictionary is searched from the last entry backwards. But any FORTH word which contains the word SPACES will *not* lose the original FORTH definition of the word SPACES. This is because these FORTH words are deeper in the Dictionary than your definition.

Now the command FORGET SPACES will remove your definition (i.e. SPACES will no longer be replaced by HOLES) and also remove all above it. But if you then type FORGET SPACES again you will remove about half of the actual FORTH dictionary that you loaded in! So remember to FORGET carefully.

Here is another short program which involves time delays. It uses do-nothing Loops for this purpose.

```
TING " ECHO
GAP 200 0 DO LOOP
GAPO 600 0 DO LOOP
S GAPO TING GAP TING GAP TING
0 GAPO TING GAPO TING GAPO TING
SOS S O S
```

Typing SOS now gives the Morse Code signal for SOS.

Then try this

```
HELP! 100 0 DO SOS LOOP
```

Type HELP! and it does it 100 times.

Throughout this article numbers are decimal. In some versions of FORTH the system starts up in HEX and in some in DECIMAL. Appleforth V 1.5 starts in HEX so you type DECIMAL at the very beginning of each program so as to stay in Decimal until you decide to change.

Now to explain the Loop construction. There are several different types but the one we have been using is the DO LOOP form. This is as follows (using the Morse Code example)

```
GAP 200 0 DO LOOP
```

The Loop is invoked by typing GAP and, as usual, hitting the Return key. This automatically sets up a counter which starts at 0 and increments by 1 up to 199 and on each step looks for something to do. In the example above it does nothing two hundred times but if it was required to do anything the word or words telling the Loop what to do would be placed between DO and LOOP. Here as there is nothing to do the result is simply a time delay. This by the way gives a good measure of the speed of the language. In this test 1000 steps of do-nothing in BASIC took 1.3 seconds on an IBM 370/115 and about 1.4 seconds on my Apple II. The equivalent in FORTH takes .14 seconds on Apple II.

Straight comparisons on all tests are not easy, and the results will obviously depend on the algorithm chosen for evaluation functions. (Number crunching is not the application in which FORTH is used to best advantage.) I shall give the results of other tests in a later article.

To look at a simple task for the Loop to perform we go back to the Morse Code example

```
HELP! 100 0 DO SOS LOOP
```

Now we see that the command SOS between DO and LOOP and defined earlier, will be executed 100 times. That is from 0 to 99. When the counter gets to 100 it stops without executing SOS. But suppose we don't want to be definite about the number of executions? We might then define

```
HELP! 0 DO SOS LOOP
```

No upper limit has been specified. We cannot now invoke HELP! as it stands but remember whenever we type HELP! *after* it has been defined it is replaced by all the words in its definition. Therefore typing

```
10 HELP
```

is precisely the same thing as

```
10 0 DO SOS LOOP
```

and so the machine outputs SOS 10 times.

The FORTH word for causing a value to be printed on the VDU is . (i.e. a full stop)

Being a word it must be spaced away from the words on each side of it by at least one space. We can now use this FORTH word to print out the first N natural numbers.

```
NATNUM 0 DO I . LOOP
```

Here I means Get The Count Value

. means Print It

If I now type 10 **NATNUM**

I get 0 1 2 3 4 5 6 7 8 9

If I prefer this printout to run from 1 to 10 I can define

```
NATNUM 0 DO I 1 + . LOOP
```

Notice that FORTH uses Reverse Polish Notation (RPN) so that to add 1 to I we write

I 1 +

which will add 1 and print the result.

Now we'll sum the first 10 natural numbers starting from 1

```
SUM 0 10 0 DO I 1 + + LOOP
```

The reason for the 0 immediately after SUM is that when we have got the counter first value (= 0) and added 1 we then add the sum to what we have already (that's what the second + is for) but there isn't any initial value to add to so we must initialise it. That's what the first 0 does.

For a sum in which the upper limit is not initially defined we define

```
SUM 0 DO I 1 + + LOOP
```

Now the first 0 defines the lower limit of the count. To sum the natural numbers from 1 to 50 you type

```
0 50 SUM
```

Here the 0 initialises the Sum to zero, 50 sets the upper limit and the word SUM is automatically replaced by

```
0 DO I 1 + + LOOP
```

Those readers who are already familiar with BASIC programming will realise that the slightly bizarre way we express ourselves in FORTH is because we avoid defining variables. This helps to make FORTH run faster and economises on memory. In BASIC we would define variables SUM and NUM and proceed

```
10 SUM = 0
20 NUM = 0
30 FOR I = 1 TO 10
40 NUM = NUM + 1
50 SUM = SUM + NUM
60 PRINT SUM
```

Now try the following simple exercises.

Define **EVEN** and **ODD** to list the first N even and odd natural numbers, the number N to be chosen at run time.

Define **SUMEVEN** and **SUMODD** to sum them.

When writing these programs arrange for the results to be written on a line below your invoked word and for **SUM Is** to be printed before the answer.

I will answer all readers' queries sent to me care of *Computer Age*.

In concluding this first article I want to suggest that if you are interested in FORTH you nag the software distributors to handle it.

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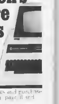

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Optional FA 1 Programme Adaptor permits programme data storage on standard cassette tape recorders for re-entry. Typical storage/re-entry time [illegible] seconds [illegible] programme reference and identification. Also [illegible] music [illegible] calculators into musical synthesisers [illegible] programmable

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OFFICE OF THE FUTURE

Howard Peters

Not since the Industrial Revolution has science and technology threatened the life styles of so many people as through the emergence of low-cost mass-produced electronic equipment The impact of robotics in industry is well-known and widely discussed bringing with it fears of mass redundancies and the creation of a new society based on enforced leisure But whereas only a small percentage of all trading companies is engaged in engineering, assembly and other industrial applications all require clerical service and administration and it is in this area that the wind of change will be most keenly felt

However, 'Office of the Future is far more than a mere reflection of improved technology, it embraces a total concept in information management and a radical change in the structure of jobs and their relationships not only internally within a business but externally between organisations Technology is the vehicle on which these changes will occur and we need to start by examining the dynamic facilities that it offers

Let us examine the four primary groups of work functions that are central to the organisation and relate the effect of both current and future technological innovation within these categories

The four are

1) Accounting, financial and administration
2) Information collection storage and retrieval
3) Correspondence and mailing
4) Telecommunications

The accounting financial and administration functions have traditionally been the first tasks to benefit from automation Within the smaller business recent years have witnessed the gradual replacement of the accounting machine with more sophisticated equipment revolving around the development of the low-cost interactive minicomputer, and more recently the micro computer and the rigid disciplines of the batch bureau are now largely being replaced, and one can expect this trend to continue With the reduction in price of hardware, and the availability of low-cost general purpose application software, the user base has mushroomed and such equipment is now within the grasp of all but the smallest organisation

The larger corporation operating through a number of dispersed locations and traditionally employing mainframe equipment can now decentralise the daily processing requirements and return control to those directly responsible for the various local functions

Information storage and retrieval embraces the area which can loosely be defined as the recording filing, and distribution of miscellaneous information including internal records and memoranda To date most businesses would see this as a low priority area for automation primarily owing to the difficulty in justifying the high capital cost of magnetic storage required for maintaining the usually large volumes of data associated with this function Electronic equipment is therefore normally limited to microfilm, photocopying and other semi mechanical equipment

Correspondence and mailing is the infant application of the computing industry brought about by the development of the word-processing machine The market potential for this equipment is enormous and will increase as hardware prices come down. It is an area where standard software meets most needs and does not, therefore attract the high cost of programming usually associated with the user-specific requirements of a particualr business

Telecommunications can be divided into two discrete components — speech and data To-date only a handful of organisations in the United Kingdom have installed computer controlled exchanges, primarily because they are not normally justifiable for the smaller network Data communications, on the other hand, once considered the 'black art within D P , is expanding rapidly This can be attributed to the considerable improvements made to software coupled with the decline of the mainframe in favour of the distributed minicomputer In addition, a wider range of terminal devices are now available, including voice response terminals, facsimile printers and numerous portable acoustically-coupled devices

The ability to consolidate these functions into a single interconnected information system must form the basis upon which the office of the future' will be created Already research and development is under way, as seen by the emergence of the Nexos/Dalphi concept of a total office system incorporating both speech and data processing

Much of the technology for such a system exists today, but there are certain fundamental pre-requisites that are still to be attained

First, the keyboard should be restricted as far as possible to the clerical functions and other routine tasks the executive and management functions demand a dialogue on a higher plane and that means speech recognition

Such devices are available now but they contain a limited vocabulary Increase this vocabulary and use it in conjunction with a screen to 'spell out' to the system misinterpreted words, and the manager has at his disposal both a means of acquiring data, and also of distributing information He may demand financial reports, circularise memos, maintain his diary and store the information for an indefinite period

Second the system should be capable of handling all the features associated with the modern computer-controlled private exchange including logging of time, maintenance of a business directory, restriction of calls etc Having overcome the problems associated with speech recognition, manual dialling should become redundant'

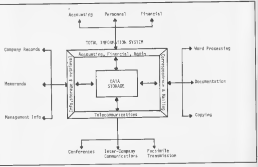
One can foresee the equipment handling multi-point access as required by, say a conference For total communication to be achieved, it requires the facility to handle video-images of the participants as well as the ability to record and display data between parties, both internal and external to the business

Third, a total information system by definition implies very large data storage much of it being constantly activated from a large number of locations This means that far higher packing densities are needed, and that accessing of such data cannot be constricted by the physical speed limitation inherent in today's disc storage media

The concept of the 'office of the future' goes far beyond the technical innovations it will affect the whole operational structure of the business organisation The formal disciplines associated with the routine tasks will become totally automated and as a work function all but disappear The informal functions as represented by management and decision-makers will become a union between man and machine with the terminal providing the means of drawing on the total knowledge of the organisation and also of inputting information for the benefit of others

There can be no doubt that the ultimate achievement of computer science will be the ability to converse with the system using colloquial speech The obstacles seem limitless and it would appear virtually inconceivable for technology to emulate the standards set by HAL in Clark s 2001, at least for some decades If one accepts that vocabulary, storage and other hardware associated problems can eventually be overcome, there still remains the fundamental problem of a logical differentiation between the nuances, meanings context and syntax associated with like sounding words inherent in any language Perhaps Orwell s 'newspeak' is the only answer, and 1984 is more than just a vision

Howard Peters is the Systems Manager of Computer Factors (Sales) Ltd



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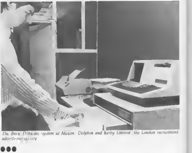

The Barc Datashare system at Moxon Dolphin and Kerby Limited the London recruitment advertising agency

BIG BUREAU...

Barc Computing Services Limited, whose founder companies were involved in the country's first computer bureau operations is jointly owned by International Computers Limited (ICL) and Barclays Bank and has computer centres in all the main population areas throughout the United Kingdom

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That base of 1500 customers has been built up by a number of different sales and marketing techniques that have been adopted over the years but let us look at how a typical Barc sales manager deals with a telephoned enquiry from an average company — say a manufacturing company with a £5 million turnover

The prospective new customer probably has a mechanical accounting machine that is producing his statements and some accounts information but it is not capable of providing as much information as he would like because, quite simply his company has outgrown it

The Barc sales manager comments that the company is obviously one of substance and is undoubtedly looking for reasonable growth, and he then suggests that he should send one of his salesmen to talk to the prospect face to face And he also requests that his man should meet both the financial director and the chief accountant so that he can get a complete working picture of the company's existing accounting and management information systems

By the end of the telephone conversation our sales manager will have established by astute questioning if the caller had the power to make decisions or if he had merely been briefed to find out what was happening in the market

The purpose of the first call on the prospect is clearly to establish a rapport find out what is really needed and also, as there is really no such thing as an average company to learn as many facts as possible about the company and its operations

After the first face-to-face call by the salesman, he will be able not only to start establishing the prospect's real needs but also to identify who in the company makes the recommendations At the same time an assessment has to be made as to whether the final decision comes from the top from a committee or from a management services section operating in a consultative capacity to line management

The salesman in conjunction with his sales manager may then decide on the in-

The computer room at Hillards Supermarkets Limited at Cleckheaton in Yorkshire where Barc Computing Services operates a management facilities scheme for the company

Bureaus

formation he has gained about the prospect's accounting needs and about the company itself to submit a preliminary outline proposal for a particular Banc package or system so that the customer can perceive the quality of the Banc service before an actual demonstration

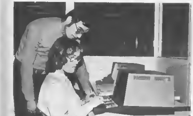
For a demonstration, the prospect will be invited to his local Banc computer centre or perhaps even to a seminar at which other prospects will be present If the prospect is showing interest in Banc's Datacare remote-batch terminal-based service then, at the demonstration, he will see the ICL 1500 series of intelligent terminals in action

When the prospect has reached the point of serious interest, he will probably request a reference from an existing satisfied Banc customer or even a visit to that customer's premises if he wants to have a look at terminal hardware actually in use

So the prospect is now convinced that in Banc he is dealing with a quality supplier and he can dispel any fears he might have about the wisdom of investing in a Banc service whether it be a basic payroll service, a terminal-based system or even a large scale facilities management scheme such as that operated by Banc for Hillards, the North of England supermarket giant where Banc staff operate the computer for the customer on the customer's premises

But this particular prospect is looking at a Datacare terminal-based system so our sales manager now needs to determine how extensive the system should be Should it comprise merely a basic 1501 terminal installed at the customer's office taking accounts information input and sending tape cassettes to the nearest Banc computer centre for processing and production of management reports? Or should it be as extensive as a disc-based terminal system with disc drive, slave terminals and a printer giving a much more complex service including such facilities as file maintenance sales invoicing, or even materials management and standard costing?

So the systems designers come onto the scene The bureau's technicians get together with the customer's staff who will be responsible for managing and operating the system when it is installed If the system is to be a particularly complex one then a list of specialists brought into the assessment situation could extend to those in stock control, standard costing, management information reporting or database systems Then they all report back to the manager on how the job will be implemented in the set time scale



The Banc Datacare system at Prestwick Circuits Limited in Ayr Scotland

Certain very important factors must be considered by the sales manager at this stage and this is where the subject of finance starts entering the picture First of all, he must ensure that the cost of the system he is thinking of selling does not conflict with the prospect's spending power On the other side of the coin if the system is likely to be a non-standard one, he must work closely with competent estimators to ensure that the prices charged enable the job to be done properly and, of course, profitably

The profit angle is vitally important because a computer bureau's continuing service to its customers can only be maintained through adequate profit margins at the end of the day

If the prospect needs finance, it is our sales manager's first recourse to make arrangements for him to discuss his requirements with banking or leasing organisations

Assuming that it is going to be a terminal-based system, hardware specialists have to be involved at the next stage Hardware procurement staff must establish the availability of the equipment and site engineers must examine power supplies at the customer's offices and seek to ensure that possible environmental difficulties are overcome

Every possible factor must be looked at before the salesman, backed by his sales manager, puts in his final proposal and the prospect becomes a customer by signing his name on the dotted line

If the bureau's service is t[illegible]ple straightforward ledger and [illegible]ting package, between one and three months could have elapsed between initial enquiry and the service going live Where terminal equipment is involved as in Banc's Datacare system that time scale could extend by about two months depending upon hardware availability and the ability of the customer's staff to adapt to the new system

Next Issue You've read about a Big Bureau Gordon [illegible] District Computing runs a Little Bureau Read a fascinating interview with him to see the similarities to and contrasts with Banc

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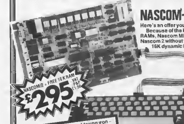

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Edward Hawthorne

THE SECRETARY: A Vanishing Breed?

Has 'wordprocessing' sounded the death knell for the two million or so secretaries and typists working in Britain? It is too early to be precise about their future but wordprocessing technology has some fundamental features whose implications for the secretarial community can already be clearly discerned.

As is common during the early stages of most new developments, the term 'wordprocessing' is being used to cover a wide range of products and techniques. However, before people forecast that secretaries are to be condemned to widespread unemployment or released from the boredom of copy typing, are to have new opportunities for job enrichment, it is as well to be clear that there are two main streams of development in wordprocessing technology.

- The one stream is text editing and storage. Devices of this type derive from the automatic typewriter. Nowadays, they are provided with visual displays of varying amounts of text, line by line correction facilities, storage on magnetic card, tape or disc recall and print-out to golf-ball or daisywheel typewriters. These are the so-called automatic typewriters, memory typewriters, editing machines and so on. They all have the merit that the typist can call back previously typed material and edit it without having to retype the whole script.
- The other stream of development uses a computer to provide, in addition to the editing functions, manipulation of the text and composition of the lay-out. For example, such a machine will enable you to find a word in a page of text simply by pressing a single key or inserting a single instruction. Or you can divert a section of text, telling the computer to hold it in its memory and then call it back for insertion later on in the script. These devices are the electronic version of the pencil and rubber scissors and glue system, used in some way or another by anybody faced with putting his thoughts direct onto paper and correcting them in draft form — with the important advantage that the computer not only produces any number of drafts but the finished copy as well.

'Any Manager worth his salt should spend a day inputting to a VDU before asking his typists to do so.'

There are many variations of device which cover the functions performed within these two streams and some overlap both. At present, most machines fall into the category defined by the first stream but it is being closely followed by the second — indeed, this article has been input direct by the author using such a machine — and there are a number of developments which will expand the scope of wordprocessing and integrate it with other office and communication equipment.

Potential of the Wordprocessor

The obvious benefits to be derived by using wordprocessors include

- A better quality product because all corrections can be made before printing.
- Increased productivity because there is no need to retype the uncorrected parts of a document. The greater the number of corrections or redrafts the more the increase in productivity, but even in documents having few changes there should be some improvement, if only because most typists slow down as they reach the end of a page. With a wordprocessor, there is no need to worry about overshooting a line or making a mistake near the end of a page, and typists can input at their highest rate over the whole page.

- Composition of the layout is simplified because the machine can be set up to produce a variety of standardised formats. For example, either one or both margins can be justified at will, phrases can be centred automatically, and some machines provide the facility for calling up standard text as required.

- Repetitive typing can be eliminated because standard phrases, letters, tabulations etc. can be set up and recalled as required.

All these relieve the strain on a typist and should therefore result in better quality and increased productivity. However, there are some snags:

- To get the maximum value out of simpler layout procedures it is important to standardise their form, the sizes of paper used and the construction of the text.
- It is vital to get the ergonomics of the system right. Any manager worth his salt should spend a day inputting to a VDU before asking his typists to do so. He will then realise that potential increases in productivity can be negatived by bad ergonomics. For example, should the screen be separate from the keyboard? Should computer file and typewriter controls be readily to hand or should the typist be forced every now and then to get up and move around?
- Inputting may become very boring with the result that there will be either no, or more moronic, takers for this job. The pressure will therefore be on for more money or job enrichment or, more likely, both.

The real benefit to be derived from a wordprocessing system lies in using it as a writing machine interacting directly with the author.

In many organisations, wordprocessors may be regarded as merely an extension of the typewriter. In reality, they are the forerunners of the electronic office in which they will function as the primary link between the manager and the organisation's total information and communication system. In this sense, they are a management working tool which enables a manager to draw information direct through his personalised computer terminal, work on it and feed back his answers. The growth in this application will depend on the development of, first, office electronic systems linking all parts of a single building or organisation and, then, external electronic

mail systems routing information direct from manager to manager in separate organisations.

Gradually, managers can expect to have direct access from keyboard to printers, copiers, filing systems and databanks, and will be able to call upon a software library which will enable them to perform a wide range of text and data manipulation tasks. In addition to the usual management routines for budgetting, planning, invoicing, etc., it is not unrealistic, for example, to envisage software which will provide automatic spelling correction or translation into foreign languages — at least for standardised phrases if not for full-blown literary texts.

Implications of Wordprocessing

It is clear that potential users have a great deal to learn about wordprocessors. But, as with all new technologies, it is also necessary for the individual to change attitudes and develop new skills, and for the organisation to change its methods of working, if the true benefits of the technology are to be obtained. The full extent of the impact of wordprocessors on the secretary and manager will only emerge as these machines are more widely used. Nevertheless, there are already some pointers to the implications of using wordprocessors.

> *'it will allow them to get away with more slipshod typing'*

1 At its lowest level, the wordprocessor will enable a typist or secretary to improve quality and presentation and to have access to a simple filing system. This will not change their job much but should make it easier because retyping will be largely unnecessary, and formatting will be simpler. On the other hand, it will allow them to get away with more slipshod typing and spelling because it is simpler to make corrections. This may lead to their job being downgraded.

2 If managers learn to touch-type, wordprocessors will enable them to dispense with much of the typing undertaken by their secretaries. This will become an increasingly significant trend at the middle management level and for all staff engaged in types of writing, such as reports, which require substantial correction and go through more than one version. Such a trend, in turn, will lead managers to improve their skills in handling information and articulating their thoughts because they, themselves, will have an interest in reducing the need for heavy corrections.

3 In the short term, established managers will probably find this too much of a chore — or an apparent reduction in status. This attitude will provide the opportunity for secretaries to take on more of the manager's tasks, such as the preparation of draft documents, and, where the processor is equipped with calculating facilities, some simple data or information processing. This will require secretaries to improve their skills in creative writing and basic mathematics.

4 Wordprocessors will improve the efficiency of the manager-secretary unit in those situations where there is a need for accurate, but repetitive, preparation of texts — as in legal documents. Managers will be able to rely on the wording of standard phrases and paragraphs always being the same, and secretaries will be able to concentrate on the new sections of text.

5 The productivity of the manager-secretary unit in terms of typing time will be substantially increased where documents have to go through several stages of drafting. However, managements will wish to ensure that this potential is not lost by needlessly expanding the paperwork or insisting on an unnecessarily high level of quality. Both managers and secretaries may be tempted to do this in order to justify their possession of a wordprocessor whilst continuing their previous method of working.

6 Even though managers may eschew the idea of doing all their own typing, they may be persuaded to use a wordprocessor to input their first draft. This would greatly increase the effectiveness of the manager-secretary unit because the secretary could then take over and feed hard copy drafts to the manager for correction. It is often easier for a manager to amend a hard copy, for example whilst travelling, and, of course, the secretary is spared the harassment of poor dictation or scarcely legible handwriting.

7 These patterns of working will become more obvious as organisations progressively move towards the complete electronic office. In particular, development of direct speech input systems will transform the manager-secretary job, downgrading the secretarial part and increasing the managerial content. However, despite much technical effort, speech inputting still seems to be some way off and is unlikely to affect the manager's or secretary's job until well into the next decade, if not the 1990's.

The Future for Secretaries — Labourer, Technician or Manager?

The electronic office may be compared with a chemical plant which is staffed by managers responsible for organising the business technicians operating the plant diagnosing and correcting faults, and labourers feeding in raw materials and stacking the output As in a chemical plant, so the benefits provided by the electronic office can only be obtained by making fairly substantial investments in new equipment, although most organisations will try to apply the new technology piecemeal so that experience is obtained before large sums of money are committed Furthermore, the application of this new technology will have an effect — often major — upon every office in an organisation

These two factors will force managements to carry out a more wide-ranging and searching analysis of office work than is usual, and this will lead them to concentrate on a number of issues affecting the manager-secretary unit, especially

- a critical examination of what managers and secretaries are doing now and how these activities relate to the potential offered by the developments in communications, information technology and office machinery
- a drive to make sure that when equipment has been installed it is not left idle This will lead to pressures to increase productivity by for example, splitting the individual secretary's tasks into a number of specialist functions each serving a group of managers

Implications

The result will be that some secretarial jobs will become production oriented and tasks will be substantially deskilled and subjected to time measurement and control The secretary will then become, say, an inputting 'labourer' having little responsibility or freedom of action

Alternatively, the secretary may become responsible for the operation of the electronic office The secretary will then be more like a technician who is capable of operating the system, diagnosing trouble, organising alternative arrangements during breakdowns and keeping track of preventive maintenance schedules

> *'the secretary may become responsible for the operation of the electronic office.'*

On the other hand, the secretary may take ove many managerial tasks and use the labourer teams as production facilities and the technicians as operators

Changes of this type will inevitably lead to some unemployment amongst secretaries and typists although it is impossible to estimate the magnitude It is more likely that staff will be redeployed although not necessarily in the same organisation The new technology could also lead to both higher wages and more part time working The former will be linked to the size of the investment in equipment and the latter to the ergonomic reality that concentrated work using electronic equipment can only be tackled for short periods

It is clear that there will be a need for training and the learning of new skills not only for secretaries and typists but for managers as well It is of great importance therefore that the extent of these technological developments are fully realised by school teachers, especially at the secondary level, for it is to-day's young teenagers who will work in the electronic office For example all this age group should learn to type and become conversant with the applications of computer technology In particular school leavers should realise that the opportunities for secretarial positions will require an increasing ability in creative writing, in being articulate and in understanding the rudiments of management

Neither wordprocessors nor the other wonders of the electronic office will carry out many of the tasks which present-day secretaries undertake The shrewd secretary will, however realise that without control of the wordprocessing function the work is reduced to running errands and that one way to retain control is to become the manager

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from p28

Wirral Super Pico Pilot (374 byte interpreter), for an unexpanded Nascom 1

'Wirral Super Pico Pilot' is a subset of PILOT It provides six operations

T	Type text or the string contained in the input buffer or both
A	Accept alphanumeric string of up to 45 characters from keyboard and store in the input buffer
M	Match string with input buffer
J	Jump relative
U	Use subroutine
E	Return from subroutine/End program

There is no need for a continuation command If a statement reaches the end of a line just keep typing and the line will scroll automatically and be interpreted correctly when the program is run An error made when typing in a statement can be corrected by the use of back space However an error in a previous statement will have to be edited out

The PILOT program consists of a set of ordered but unnumbered statements any of which can be labelled with the program marker * Each statement consists of an optional marker optional conditioner operation letter and an argument or text field

TYPE — prints text contained in its text field with the contents of the input buffer printed out wherever $ is placed

ACCEPT — stores any alphanumeric string of 45 characters or less in the input buffer (The top line of the screen)

MATCH — searches the input buffer for a sequence which matches a given sequence The result of the match sets a flag The given sequence may be a search for a single string *either* of two strings (or more) or a sequential search for *both* of two strings (or more) SPACES and ARBITRARY CHARACTERS may be indicated

As a concession to the limited memory of the standard NASCOM 1 the pico pilot conditioners Y and N are placed *in front* of the operation letter rather then after it J:*A is also abreviated to J:0

The interpreter uses 374 bytes from 0C50 to 0DC5 The rest of RAM from 0DC6 to 0FFF on a standard NASCOM 1 is all available for the program written in Pilot

The interpreter is entered by executing from 0C50 On entry the screen is cleared and PILOT is displayed You are now in the EDIT (write) MODE Program statements can be typed in Each new statement must start on a new line At any point in the edit mode < (shifted) causes a return to the start of the program statements and they can be displayed one at a time using ! To replace a line display each line up to, but not including the one to be replaced then enter the replacement line It should be terminated with % and must be no longer than the line it replaces otherwise all subsequent lines must be replaced by typing in again

<	return to start of program to edit (< is shifted)
>	run current pilot program (> is shifted)
!	display next line of program during edit
%	fill rest of line with nulls up to start of next line (Do not use at the end of a match statement Continue to next line then use)

T:xxxx	Type text xxxx
T:xxx $ xxx	Type text with the string $ (contents of the input buffer) inserted where shown Leading spaces ignored
A	Accept alphanumeric string and store in input buffer Input of less than 45 characters *MUST* be terminated with a full stop before the pilot program will accept it
M:yyyy	Search input buffer for a match with the string yyyy
M:aaaa bbbb cccc etc	Search input buffer for match with aaaa or bbbb or cccc etc
M:aaaa&bbbb&cccc etc	Search input buffer for a sequential match with aaaa and bbbb and cccc etc
M:aaaa&bbbb cccc etc	Search input buffer for a sequential match with aaaa and bbbb or for a match with cccc etc

* can be used to indicate any arbitrary alphanumeric character in a match statement but not a space, a comma or brackets etc

A space left in a match statement indicates that it must be matched with a space In the case of a space before a single string right at the start of the match statement then the string must occur in the input buffer either right at the start of a new 'word' ie after a space

J:0	Jump back to previous accept statement
J:n	Jump forward to the nth program marker (n can be 1 to 9)
U:n	Call subroutine at the nth program marker
E	Return from subroutine /End program

* is used as a program marker

Conditioners

Y	Do statement if the result of the last match was yes
N	Do statement if the result of the last match was no

Conditioners can be placed *in front* of *any* operation letter

Statement format is

(OPTIONAL PROGRAM MARKER) (OPTIONAL CONDITIONER) (OPERATION LETTER) (TEXT) or (ARGUMENT)

```
examples  T:HELLO
          A
          M:HELLO
          YT:HOW ARE YOU
          NJ:1
          E
          *T:SAY HELLO THEN
          J:0
```

Spaces *must not* be left between the marker conditioner operation letter the colon or the argument If a space is left in the string of a match statement it is taken to be part of the match A space in the text field of a type statement is printed as a space

At the end of the execution of a Pilot program key < to return to EDIT MODE Follow this with > if you want to run the same program again To write a new program simply type it in once you have returned to edit mode Terminate it with E. otherwise you may run on to the end of your last program A loop can be escaped from by pressing reset and then executing from 0C50 again Pilot programs can be dumped to tape from 0DC6 to 0FFF after returning to the Nascom 1 monitor

If you wish to clear the screen during the execution of a pilot program use the statement

T {shifted backspace} {newline}

This will clear the screen (i) as it is entered, (ii) whenever it is called up in edit mode, (iii) during the execution of the Pilot program BEWARE, it also clears the input buffer!

The statement T {newline} entered in the Pilot program causes the screen to be scrolled by one line when it is executed

Listing

```
0C50   31  33  0C  EF  1E  90  69  8C
0C58   6F  74  1F  00  21  C6  0D  CD
0C60   8F  0C  FE  3C  28  ED  FE  3E
0C68   28  2C  FE  1D  20  03  28  18
0C70   EE  FE  21  20  05  CD  94  0D
0C78   16  E5  FE  25  20  0D  3E  1F
0C80   CD  3B  01  BE  28  05  36  00
0C88   23  18  F8  77  23  18  D0  CD
0C90   3E  00  CD  3B  01  C9  21  C6
0C98   0D  01  FA  00  C5  EF  1E  00
0CA0   28  23  7E  FE  41  FA  A1  0C
0CA8   FE  59  28  04  FE  4E  20  09
0CB0   BA  28  EE  7E  23  FE  1F  20
0CB8   FA  FE  41  20  30  22  C4  0D
0CC0   3E  20  CD  92  0C  E5  06  2C
0CC8   04  CD  8F  0C  FE  1D  28  F8
0CD0   FE  2E  28  07  10  F3  3E  20
0CD8   CD  92  0C  EF  1F  00  11  CA
0CE0   0B  21  4A  0B  02  30  00  ED
0CE8   B0  E1  23  23  00  FE  4D  20
0CF0   5D  23  23  16  4E  22  1D  0C
0CF8   DD  21  CA  0B  7E  DD  BE  00
0D00   28  2C  FE  2A  20  07  DD  7E
0D08   00  FE  2F  30  21  CB  42  2A
0D10   1D  0C  28  04  16  4E  18  E4
0D18   DD  7E  00  FE  2E  20  25  7E
0D20   FE  1F  28  27  FE  2C  23  20
0D28   F6  22  1D  0C  18  CA  23  18
0D30   59  7E  FE  2C  28  12  FE  26
0D38   20  06  23  22  1D  0C  18  04
0D40   FE  1F  28  04  DD  23  18  B4
0D48   7E  FE  1F  23  20  FA  FE  55
0D50   20  07  23  23  23  E5  28  18
0D58   06  FE  4A  20  15  23  23  7E
0D60   E6  0F  47  20  05  2A  C4  0D
0D68   18  08  23  7E  FE  40  20  FA
0D70   10  F8  FE  45  20  13  E1  7E
0D78   FE  0A  28  03  C3  A2  0C  CD
0D80   3E  00  FE  3C  20  F9  C3  50
0D88   0C  FE  54  20  05  23  23  CD
0D90   94  0D  18  E8  7E  FE  24  CC
0D98   A3  0D  CD  3B  01  FE  1F  23
0DA0   20  F2  C9  E5  21  CA  0B  06
0DA8   2F  7E  FE  20  20  07  23  10
0DB0   F8  3E  24  E1  C9  7E  FE  2E
0DB8   28  06  CD  3B  01  23  18  F5
0DC0   E1  23  7F  C9  00  00  00  00
```

Execute from 0C50
DUMP 0C50 → 0DC5 (374 bytes)
USER RAM 0DC6 → 0FFF
STACK AT 0C33

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THE PERIPHERAL CONNECTION

David Shear is a Product Marketing Manager with Data Recording Equipment Ltd (DRE) one of Europe's largest peripheral manufacturers. He has a wide experience of many facets of the computer industry and has specialised in disk drives over the last few years.

In this article, David Shear takes a look at the basics of disc drives. After covering principles of operation and a survey of drive types, he examines choice and care of drives, finishing with a look into the future. The aim of the article is to demolish some of the barriers of understanding between users and suppliers, thus encouraging a dialogue on more equal terms than today.

Future articles will discuss printers and VDUs.

Wherever mini and microcomputers are being discussed, it is seldom that the conversation turns to peripherals. Yet a system is not complete until the peripherals are added, and in assessing the usability, performance and reliability of any complete system the peripherals play a major, sometimes dominant role. A thorough investigation of even the commonest peripherals is beyond the scope of a single article, so here we concentrate on the least appreciated and least understood — the magnetic disc drive.

Types and roles

Three basic drive types exist today: fixed-head (or head-per-track) drives with their close neighbours, drums, floppy disc or diskette drives, and hard disc moving head drives. Fixed head discs and drums are relatively expensive and little used outside special purpose applications, so only passing references will be made to them.

Disc drives are used to store large amounts of data that must be accessed randomly. Incidentally, random access devices are those which can retrieve data from one of many addresses without having to move through all of the intervening data. The other type of access is serial-access, as, for instance, in a magnetic tape drive. The data capacity of disc drives starts at about 100Kbytes and goes up to around 600Mbytes, with a capacity to use multiple drives per system. As microprocessor systems increase in power, even the large-capacity drives are being commonly used in applications using large files and data bases.

Disc drives can be divided into categories in several different ways.

The low capacity drives — floppy or diskette drives — exist in 5¼" and 8" sizes (the measurement shows the diameter of the recording disc), where the media is always removeable or exchangeable. Larger capacity drives use rigid, or hard discs of either 8" (approximately) 10" or 14" diameter. Several discs, or platters, may be fitted to a drive, and they can be exchangeable, fixed, or a combination of both.

Exchangeable discs are housed in two types of package — cartridges and disc packs. A cartridge is an all-enveloping plastic housing with a flap to allow access for the recording heads, and can be loaded into a drive from the front, or from the top. A disc pack usually contains many platters, whereas a cartridge contains usually one platter, and sometimes two. The disc pack is housed in a plastic chamber with a removeable base, and when fitted to a drive the housing is removed entirely from the pack.

Whatever classification is used to separate disc drives, they do have many common features, and a look at the basic components of a disc drive will help build up the picture.

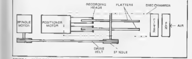

FIGURE 1 — BASIC DISC DRIVE MECHANICS

Construction

Figure 1 shows the major parts of all disc drives. At their hearts are two motors, one to spin the discs, and the other, maybe less recognizable as a motor, to move the head positioner. In addition to the motors we have read/write heads and associated circuits used to record data on the discs and read it back again as required. The recording heads are mounted on arms attached to the positioner, which moves them about the disc surfaces to access different data blocks. Closely associated with the positioner, or actuator, is a servo system to control the movement of the positioner. Added to this is a series of control circuits to give command signals to the various drive functions, and an interface section to communicate with the computer system. Hard disc drives, needing clean conditions to work correctly, also have air filtration and circulation systems. To properly understand functions of some of these mechanisms, it is best to first examine the layout of data on the disc, and the way in which data is recorded.

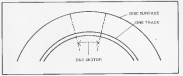

FIGURE 2 — DATA LAYOUT

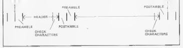

FIGURE 3 — DATA FORMAT

Magnetic disc recording

Magnetic recording is fundamentally the same, whether considering high technology disc drives or a cheap domestic cassette recorder. Electrical signals are fed through the coils of a read/write head and converted into a magnetic field, which orients the magnetic particles in the coating of the media being used.

In digital recording the coating is saturated in one direction or the opposite to represent bits of data. In disc recording only one track at a time is recorded, thus the data has to be serialized into a bit stream, either within the drive or, more commonly, in the controller. Several different schemes for encoding data and clocking signals are used, the aim being to record the least number of magnetic flux changes to represent the required data. Obviously the less flux changes required the more data can be packed into a given space. Clock signals are necessary to provide the means to correctly identify where the presence or absence of a flux change represents data bits, and also to keep detection circuits operating correctly when no flux changes for data (i.e. data zeroes) are present.

A review of different recording codes could fill a book, but the most common schemes to be found are 2FM (double frequency mode) and GCR (group code recording). When data has to be exchanged from one drive to another, it is an obvious necessity to ensure (amongst other things) that the data encoding scheme used is the same on both drives.

Figure 2 shows the layout of data on a disc. Data is recorded in blocks of several bytes, common sizes of blocks are 256 and 512 bytes, though many other standards exits. A track of data is divided into sectors which contain the data block and certain control information. Sectors are identified in several ways, by physical markers (e.g. slots cut into the disc hub), by pre-recorded markers on the disc, or a scheme called soft sectoring can be used — this is popular on floppy discs. Hard sectors are identified by a suitable mechanism in the drive, for instance a reluctance pickup is used to sense slots cut into a metal hub, and converted into a stream of pulses. Sectors have addresses, and the start address on any track is defined by a separate marker, called the index.

Soft sectoring allows the use of variable length data blocks (but even so, fixed length blocks can be and are used). In this scheme, a special code within the control information at the start of a data block indentifies the start of a sector and its address.

Tracks also have an address, starting at zero for the outside track. Coupled with the sector address and a head address (to specify which surface of which disc is being referred to) it can be seen that each data block on the disc can have a unique address, each part of which refers to a physical or recorded marker on the disc.

When a sector of data is recorded, several other things are recorded at the same time. **Figure 3** shows the format of a typical sector. The pre- and postambles are to allow for mechanical and electrical tolerances, when overwriting and inserting data blocks, and also contain special synchronization bits to set up detection circuits to differentiate between recorded data and clock pulses.

Headers are used to supply information on the address of the data block, and sometimes to describe some of the data attributes, such as block length. In the example shown the header is independent of the data, but this is not always done. One advantage of separate headers however, is the ability to check the address of a data block before rewriting it, by reading the header before switching into write mode. This is a powerful technique for ensuring data integrity, and a system which uses true, or separate, headers will be more reliable than one which does not.

Also note the check characters appended to each recorded field. On small systems these are merely used to check the longitudinal parity of the block but on larger or on better thought-through small sytems, a CRCC (cyclic redundancy check chracter) facility can contain enough information to reconstitute bits of data in error.

Understanding the data layout now lets us appreciate better some of the parameters quoted in disc drive specifications. Three factors govern the amount of data which can be recorded on a disc drive, these are: the number of tracks per surface, the number of bits of data per track and the number of discs. These in turn are governed by the tracks per inch (tpi) capability and the bits per inch (bpi) capability. Having seen the space used for non-data overheads also shows the difference between the unformatted, or total, drive capacity, and the formatted, or data, capacity. When reading specifications, be sure to keep this in mind.

Positioning Mechanisms

Since each head records only one track, it is necessary to move the heads as quick

Peripherals

ly as possible between different tracks. This is accomplished by the positioner, also called the actuator or access motor. Positioners come in many types, the most commonly used today being stepper motors and voice coils. Stepper motors are connected to the head/arm assembly via either a lead screw on the motor shaft, or via a flexible band wrapped around the motor shaft. The latter is a newer arrangement which can operate faster, but both are widely used on floppy disc and low-cost fixed disc drives.

The voice coil positioner works on the principle of a loudspeaker (hence the name!). The coil is part of an assembly attached to the head/arm carriage, and is held within a magnetic field. As a current is passed through the coil, it will move either forwards or backwards, depending on the current direction.

Positioners move in one of two senses, either along a radius of the disc, or in an arc rather like a record player arm. This latter is showing up on several of the newer disc drives, and is driven in various ways, using stepper motors, adapted voice coils, and sometimes attached at the pivot point directly to the motor shaft.

It can be seen that just moving the positioner is not enough; we have to know exactly where it is at any time, and control its movement to any new destination. This requires a positioner servo, which exists in open and closed loop forms. In an open loop servo, there is an independent position sensing device, partly attached to the head carriage, and partly to the main disc unit. This can take several forms, typical ones being a photo-diode sensor and etched grating, or primary and secondary coils on a linear transformer. These must provide a pulse, or output, corresponding to each track position.

Closed loop, or self-referencing servos, rely on information recorded on the discs, and picked up by a read/write head. Some drives use a dedicated servo surface, with a complete servo track identifying the track position for each cylinder (a cylinder is the totality of equivalent tracks on each recording surface). Another technique is to use the preambles, and other unused spaces in the recorded format, to provide servo signals. This latter uses up less of the available disc space, but at the expense of extra electronic circuitry.

Open loop servos are widely used up to track densities of around 200tpi, on both floppy and hard disc drives. They do have one big disadvantage though, and that is the reference set-up requirement, when used with exchangeable disc drives. Obviously, to exchange media between different drives, all tracks have to be in the same position on each drive. This can only be achieved by setting them up using an external reference standard. This consists of a specially recorded disc called a C.E. (Customer Engineering) disc, and the use of an oscilloscope and special tools. Such set-ups need regular checking by an engineer, particularly if a drive is transported, or when initially installed. Hard disc drives in particular need regular checks, as the margins for misalignment are very small.

Positioner servo circuitry has electronic and electro-mechanical refinements of several kinds to ensure good performance over a wide temperature range, and positioning, or seek, errors are normally specified as better than one error in 10^8 seeks.

This brings us to another major performance parameter in disc drives, the seek time. As a measure of performance, several seek times are often quoted, the one track, or adjacent track, time, the maximum time, from the innermost to the outermost track — or vice-versa, and finally the average seek time. Depending on the application each of these times may assume major importance. Typical average seek times are 25ms to 80ms (ms - milliseconds) for a hard disc drive. For floppy disc drives which usually only seek in a track-by-track mode, the access time is normally 3ms to 10ms for 8" units, and 25ms to 40ms for 5¼" units, floppy discs being considerably slower than hard discs on average seeks.

When any computer system is heavily engaged in disc activity, it can be seen that seek times will play a major part in system throughput. There are, however, some other factors to consider when looking at the time to transfer a block of data, and the first of these is the disc rotation speed, specified as latency. Latency is the time required for one disc revolution, usually specified in ms. Hard disc drives spin at 1500, 2500, 3000 or 3600rpm usually, whilst floppy discs spin at 300 or 360rpm. Thus the access time to a block of data is the sum of the seek time, plus an undefinable amount to account for the wait until the correct sector arrives under the head. Average access time is thus normally quoted as average seek time plus average latency (the time for one half of a revolution). Beware, however, as many manufacturers mix access time and seek time, and often call the seek time the access time. Ensure that when comparing specifications you know exactly what is being quoted.

On floppy discs in particular, two further times are often quoted, the head settling time, and head loading time. The former is the time required for the positioner to settle on a track position after reaching it, the latter is the time to push the head into contact with the disc, where it can begin to read and write.

Top loading Cartridge Disc Drive Fixed + Exchangeable Model 4000B

Flying Heads

There are two distinct types of heads on disc drives, and as mentioned in the previous paragraph, floppy disc heads, which operate in contact with the disc surface, are one of them. This is only suitable for low disc speeds, otherwise serious wear problems would set in. This problem was solved by IBM some 25 years ago, by the introduction of the flying head. In this head the actual read/write poles are set into an aerodynamically shaped plastic (or similar) disc. As the disc rotates at high speed, the Bernoulli principle takes effect, and a layer of air is pulled around close to the disc surface. This moving layer of air enables the head to fly, and by varying the size and shape of the head, and the disc speed, different flying heights can be achieved.

Two distinct types of flying head are available, those who take off and land on the disc surface, and those that are held away from the surface until the disc has reached a high speed, and then loaded towards it. Take off and land heads ware one of the very first types of flying heads, and are now making a big comeback in the latest technology (code named Winchester); they are only suitable, however, for fixed discs, as obviously the disc cannot be removed unless the heads are out of the way — see figure 1

Floppy disc heads are of three main types. The basic single side head consists of a rigidly fixed head with a solenoid operated pressure ped on the opposite side. A head load command pushes the pressure pad onto the disc which in turn pushes the disc onto the head. On two side recording drives one type has a similar fixed head with the other head operating in place of the pressure pad; the second type uses two heads which move together. These are respectively referred to as fixed and compliant and double compliant. The major problem on double sided floppy recording is to prevent wear when the heads are repeatedly loaded together and many detailed variations in head design have been made to try and overcome this problem.

One final point on the subject of heads concerns cleanliness. **Figure 4** shows the flying height of a typical disc head and the size of likely contaminants; such a picture should always be borne in mind when using disc drives. It cannot be stressed too strongly that serious efforts must be made to keep dirt away from media when outside a drive and away from the insides of drives. Dirt is the cause of most head crashes, so-called as the flying head hits the disc surface and will cause permanent and expensive damage to the heads and media. One final word of warning: if you suspect that you have such a problem NEVER try another disc in the suspect drive — such a way can only result in DISASTER.

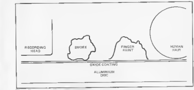

FIGURE 4 — KEEP CONTAMINATION OUT!

Fixed versus Exchangeable

At first sight the suggestion that fixed discs could be preferred to exchangeable may seem to be a non starter. But consider some of the advantages. The heads and discs can be sealed in a contamination proof chamber; the heads can be landed on the disc which can help to prevent damage during the critical head loading phase and critical mechanical tolerancing, designed to ensure the exchangeability of media between units, can be eliminated. Winchester technology, the latest disc techniques available (invented again by

The IMI 7710 disk drive

IBM), takes advantage of all these points It allows the use of heads which fly very close to the disc surface thus increasing the resolution capability of the head This enables very high track and bit densities to be achieved particularly if coupled with a closed positioner servo Already drives are becoming available with capabilities of 800tpi and 10,000bpi. Such increases in drive capacity, at relatively low cost are impossible to achieve with exchangeable disc drives, and a further significant advantage for small computer users is the substantial increase in reliability

As can be seen, however, there is a major disadvantage in that copies of data cannot be made for security purposes or to provide an increase in the off line data base Fixed discs are often partnered with another device such as a floppy disc or cartridge tape drive, to provide this security facility Care must be taken when choosing such a combination in a system to ensure that the backing-up techniques available do not give you the problem of transferring, say, a 50Mbyte fixed disc onto 50 floppies at the end of each day Such a proposal is doomed to failure in two ways firstly the sheer inconvenience and library control needed and secondly that the back-up device could be less reliable than the fixed disc

Do not be misled into thinking that FEDS (Fixed and Exchangeable Disc Stores) are the complete answer Whilst they are complete systems solutions in their own right and can be a good choice in the right circumstances they do not offer, today, the advantages of reliability cost and immunity to contamination of the Winchester units

	MEDIA		MAX		SERVO
			TPI	BPI	
FLOPPY	REMOVEABLE	FRONT LOADING ENVELOPE	40	5000	OPEN LOOP
2314	REMOVEABLE	DISC PACK			OPEN LOOP
2315	FIXED/ REMOVEABLE	FRONT LOADING CARTRIDGE	200	2200	OPEN LOOP
5440	FIXED/ REMOVEABLE	TOP LOADING CARTRIDGE	200	2200	OPEN LOOP
3330	FIXED/ REMOVEABLE	DISC PACK			CLOSED-LOOP
3330-II	FIXED/ REMOVEABLE	DISC PACK			CLOSED-LOOP
Winchester	FIXED	FIXED	800	10,000	CLOSED LOOP
Piccolo	FIXED 8"	FIXED	800	10 000	CLOSED LOOP

TABLE 1 TECHNOLOGY TYPE NUMBERS

Generic type numbering

When looking at disc drives, certain type numbers will keep recurring These are a reference to the IBM type number for particular technologies **Table 1** shows a list of the major type numbers you will encounter along with their attributes Since IBM invented virtually all the major technologies, these type numbers have established common usage alongside individual manufacturers' model numbers

There are some technologies notably the interspersed or embedded servo where the positioner servo information is in the gaps between date and non standard disc sizes such as 10" where no equivalent IBM type number exists Generally these have been pioneered by companies with much less market dominance than IBM, and can suffer from being unique to a particular manufacturer This can give rise to the inability to transfer media with other manufacturers units and sometimes extra cost and restricted availability of such media

Part II Disc Drives for Microcomputers will appear in the next issue

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INFORMATION: The Art of Power?

In the struggle for controlling the sources and channels of information fresh meaning is given to the biblical phrase "It is better to give than to receive"

They say that the old Mexican revolutionary songs used to be constructed so that reference to various enemies, friends heroes and traitors could be changed around at will such was the volatility of the situation The computer songs I sing that is to say the seminars, the words I write and the chats in pubs, often seem to require the same degree of flexibility (some would say hypocrisy)

As the newly appointed Research Fellow in computing at the Royal College of Art, I find myself oscillating between positions that no holophrenic person (I made that up but you know what I mean) could maintain simultaneously Five minutes after lambasting the absurd fixation of many computer people with number with the quantitative instead of the qualitative one finds oneself insisting, to someone who wants to portray a 3-D rotating teapot on the computer screen, that they'd better learn some trigonometry and matrix manipulation

One nods and smiles wisely on hearing that the director of the film Alien superimposed clanking teletype sounds over shots of a (silent) vdu to make it appear 'real Then the whole of the next day is spent with a person who wants to get some 'computer stuff' into a short film and who insists that an aged teletype is the thing

Well that's how it is whether you or I like it or not in the field of art and to only a slightly lesser extent design, there can be found the entire spectrum of emotions knowledge prejudices, wisdom over enthusiasm and blind hatred towards computers

The fashion designer who goes to the movies listens to the music looks at the people and then designs next year's clothes, won't have anyone mucking around with *her* creativity, thank you very much The ceramics designer, however, would love to be able to write a simple BASIC program to simulate a lump of clay being coaxed into shape on a wheel

Then there are those who see it all — you know the Information Technology Revolution and stuff — as being a wonderful thing that will free us and change things

They say Information is power! I argue 'No power is power Because I don't think that access to all sorts of information necessarily helps me at all Information may be *necessary* for power but it is not sufficient and does not bestow power

We've just got a nice new terminal at the Royal College of Art which will hook up to various databases here and in the USA It will provide us with fast valuable printed information across a wide range of disciplines including technologies and the humanities But surely we should not pretend that access for example to the brand names and prices of all the tinned peas that Tesco sell will give us power as

Discourse

consumers of them? Similarly, *knowing* all about one's social security or tax entitlements does not give one the power to alter things the state does that

The human brain only functions 'normally' by *rejecting* much of the information that comes to it via our senses The clock ticks and ticks and ticks "*boring*" says the brain and you cease to hear it But let that clock suddenly stop ticking: "hey! — something's happened — not sure what — oh the clock's stopped — phew!"

We can only hold about seven chunks of information in our head at once So we structure we literally make sense of' the clutter of data that comes to us via our eyes, ears skin and so on But — and this is the point — we don't all do it the same! You and I see the same colour — yet you call it blue while I insist it's nearer green The Tory and Socialist presumably see (at least sometimes) the same world — yet they may make completely different sense of it

So — bombard me with information and I shall bundle it up into manageable chunks using categories, dimensions of my internal representation of the world that suit me

Ah-ha but if I am an information *provider*, I will also be doing that To give you information, I have first to digest and structure it in some way Does anyone suppose that information to do with change in the world (the most important kind, surely) is going to pour equally objectively and somehow 'neutrally' from the mouths databases computer models etc of Left and Right of academia and business man of serialist and holist thinker, of you and me? No chance

One more question Who owns the information channels? Who does the data come from? In whose interests was it to provide it? (Well three questions then)

People say that when we all understand about computers (at what level and who draws the distinctions between one level and another and why?) then we'll somehow be able to sanitize to purify the information that comes to us from or via machines They seem to imply with Marshall McLuhan that "the medium is the message"

The human brain only functions 'normally' by rejecting much of the information that comes to it

I think though that 'the message is the message" If I am right if power is power and the message is the message then the information revolution the computer boom *as a democratising force* virtually vanishes leaving the same old problems the *context* still to be considered

I think there's a war on a class war an information-rich versus information poor war a money war At the very least to quote the poet Leonard Cohen "There is a war between the ones who say there is a war and the ones who say that there isn't"

Information, computers the technology', are as 'neutral' as a Party Political Broadcast The machinery the methodology and systems come to embody the power structures of the society in which they are created

I'm lucky In a post graduate art university we can amongst other things toss around some of these ideas and questions and ask what if ?' The picture is of me celebrating the fact surrounded by the means to do it

We have terminals colour graphics a storage display micro computers, timesharing links something old something new something borrowed and something (an Altair 8800b with twin disc drives) blue

Softly nicely and ever-so-neutrally I'm going to try to change art and design a little bit, and computing a little bit Just a little *little* bit

I look quite happy don't I? You wouldn't think there was a war on

SOFTWARE
• PET • Z80/CPM • 6800 •

This is how your business appears on the screen
Approx 60 entries update only 1-2 hours weekly and
your entire business is under control

*Programs are intergated
Select Function by Number
01 *Enter New Names/Addresses
02 *Enter/Print Invoices
03 *Enter/Purchases
04 *Enter A/C Receivables
05 *Enter A/C Payables
06 *Enter/Update Stocks Received
07 Enter Order Received
08 Exam/Create Update Bank Balance
09 Exam/Create Sales Ledger
11 Exam/Create Order Book
12 Exam/Create Product Sales
13 Print Customer Statements
14 Print Suppliers Statements
15 Print Agents Statements
16 Print Quarterly Statements
17 Print Week/Month Sales
18 Print Week/Month Purchases
19 Print Year Audit
20 Profit/Loss Account
21 Update End Month Files
22 Print Cashflow Analysis
23 Enter Payroll
24 Return to Basic

Which one (enter 1 to 24)

Each program goes in depth to further express your requirements

For example (9) allows (a) list of sales (b) monitor sales by stock code (c) invoice search, (d) amend ledger files (e) total all sales

Business Program Version 1
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This survey is by the new magazine for the PET Printout, edited by ex-Commodore man Richard Pawson. It is printed here as a service to PET owners. We stress that publication does not imply Computer Age endorsement. See Brand News, this issue, for address of Printout.

We looked at some of the eighty-plus programs advertised as suitable for business use on the PET.

It was not possible to conduct a full evaluation of all titles, however we did examine some of the best known programs.

Quality ranged from highly professional to laughable. A small number of programs were so bad that they have been excluded. We were unable to evaluate software from two companies who failed to respond to enquiries.

Conclusions

On the whole price proved to be a fair indication of quality, although we would advise any businessman considering using ledger and payroll packages to have them checked by a professional advisor prior to purchase. Remember: There is no such thing as a bug-free program.

A number of the cheaper programs really provide no more than a basic structure requiring tailoring to meet the individual needs of the purchaser. Since the rates for professional programming vary between £8 and £15 per hour, work of this nature would undoubtedly exceed the cost of the original. Several users reported that they had converted commercial programs themselves with acceptable results.

The comprehensive packages we looked at in detail conformed to a high standard overall. Prospective purchasers with non-standard book-keeping systems might be obliged to amend their own systems, as relatively little customizing is possible with standardized software. Nevertheless, we believe that many of these packages offer outstanding value. One supplier markets substantially the same software on a well known mini at eight times the price.

Best Buys

The following packages appeared to us to offer exceptional value for money. It is stressed that PRINTOUT has not been able to test them to destruction. Prospective purchasers therefore should satisfy themselves as to the suitability of a particular package to their application.

PETACT Stock Control	£350
PETACT Sales Ledger	£350
PETACT Purchase Ledger	£350
PETACT Sales Invoicing	£350
Wordcraft Word Processor	£325
Computastore Payroll	£195
HB Sales Ledger	£350
Commodore Stock System	£150+
GW Business Program package	£575
Commodore Business Information System	£150+

Title	[illegible]	Minimum Configuration	Supplier	Notes
[illegible]	[illegible]	8K Cassette	[illegible]	Updates & [illegible] placed an[illegible] age not [illegible]
[illegible]	[illegible]	8K Cassette	[illegible]	Handles [illegible]
B[illegible]	[illegible]	32K PET & Commodore Disk	[illegible]	[illegible] Reversals [illegible] Specifications vary
Business [illegible] System	150+ installation	32K PET & Commodore Disk	Commodore Business dealers only	Fast data storage and [illegible] company records
Costing	10	8K Cassette	Commodore Dealers	Cost report generating system [illegible] up to 200 descriptions and costs
Cash Flow Analysis	8	8K Cassette	Aztec	Handles up to 30 project cash flows simultaneously
Commodore [illegible]	[illegible] installation	32K PET & Commodore Disk	Commodore Business dealers only	Handles up to 1300 products. Produces audit trail and running balances
Dealers Letter	4	8K Cassette	Petsoft & Dealers	Tests age of invoices entered and prints out reminder letters of varying severity
Forecast	[illegible]	8K Cassette	Petsoft & Dealers	Forecasts trends from daily, weekly, monthly or yearly sets of figures e.g. Sales
Invoicing	5	8K Cassette	Petsoft & Dealers	Order entry via formatted screen for automatic invoicing of up to 225 product lines
Job Evaluation	25	8K Cassette	Petsoft & Dealers	Computes relative weighting of factors comprising jobs up to 8 using correct Job Evaluation formulae
Mailing List	15	8K Cassette	Petsoft & Dealers	Handles mailing and labelling
Payroll Cassette	15	8K Cassette	Petsoft & Dealers	Basic package, update service available
Payroll Disk	[illegible]	32K PET & Commodore Disk	Petsoft & Dealers	Caters for up to 200 employees per diskette. For [illegible]. Update service available
Percentage Costing	[illegible]	8K Cassette	Petsoft & Dealers	Handles costing with up to 100 cost factors
PETACT Sales Accounting	[illegible]	16K PET & Cassette	PETACT Dealers	Sales Ledger Package. Links to Sales Invoicing package. Price includes user training
PETACT Sales Accounting	350	32K PET & Petsoft Disk or Commodore Disk	PETACT Dealers	Disk version handles 1000 Accounts. Cassette version 200 Accounts
PETACT Sales Invoicing	350	32K PET & Petsoft Disk	PETACT Dealers	Links to PETACT Sales Accounting package. Price includes user training. Handles 1000 accounts
PETACT Stock Control	350	32K PET & Petsoft Disk	PETACT Dealers	Handles 25 files holding 300 stock items = 7500 item capacity. Full Audit trail. User training included
PETACT Purchase Accounting	350	32K PET & Petsoft Disk or Commodore Disk	PETACT Dealers	Handles 1000 Accounts. Purchase Ledger. Price includes user training
PETAL Analysis	50	8K & Cassette	ACT Bristol	Management Accounting. Data entry via PET. Tape then bureau processed
PETAL Purchase Ledger	50+	8K & Cassette	ACT Bristol	PL [illegible] remittance advice [illegible] and [illegible] transfers
PETAL VAT Analysis	50	8K & Cassette	ACT Bristol	VAT analysis. Data entry via PET then bureau processed
PETAL Sales Ledger		8K & Cassette	ACT Bristol	Statement, Remittance advice, Dealers control list and overdue letters. Bureau processed
Portfolio Management	9	8K & Cassette	Petsoft & Dealers	Sorts and compares share prices advising stop loss, start and take profit situations
Profit & Loss	2	8K & Cassette	Petsoft & Dealers	Prepares Profit & Loss Account
[illegible]	20	8K 1st & 2nd cassette decks	Commodore Dealers	Suited [illegible] where transactions are entered once daily
Sales Analysis	10	8K & Cassette	Petsoft & Dealers	Handles up to [illegible] salesmen up to [illegible] departments over 12 months and [illegible] charts results
HB Sales Ledger	350	32K PET & Petsoft Disk	HB Computers	Monthly balance ledger system handling 800 accounts and 400 postings p.m.
Standard Letterwriter	10	8K & Cassette	Petsoft & Dealers	Personalises and prints multiple copies of any standard letter text
Stockbroker	20	8K & Cassette	Petsoft & Dealers	Share price watching and yield calculations
VAT Pack	17.50	8K & Cassette	Petsoft & Dealers	Processes and stores input and output VAT items. Displays VAT return details
VAT Scheme D	15	8K & Cassette	Petsoft & Dealers	VAT computation for retailers
Word Processor Commodore	75+ installation	16K PET & Commodore Disk & printer	Commodore Business dealers only	Right justification, variable margins and page lengths. Multiple copies of form letter with variable insertions
Word Processor Wordcraft	325	32K PET & Commodore Disk & printer	[illegible]	Screen selecting many [illegible] options, right justification and advanced text processing features
Word Processor CMC Cassette	25	8K PET & Cassette & printer	Petsoft & Dealers	Line length, left margins, centering and skip. Insertion & deletion of words and lines
Word Processor CMC Disk	38.50	16K PET & Petsoft Disk	Petsoft & Dealers	Line length, left margins, centering and skip. Insertion & deletion of lines

Notes:
Prices quoted are exclusive of VAT

The degree of support offered by suppliers varied considerably, as did installation charges. On the one hand, PETACT Business Systems included a one day's training course in the price. On the other, dealers quoted between £10 and £136 for installation of some of Commodore's programs.

Richard Hooper

Maybe there's no need to set up a personal computer network. Maybe, if mass demand lowers prices, that's exactly what Prestel will offer. Maybe.

THE EMPTY MACHINE

Homes, Personal Computers and Viewdata

> *'The main requirements of the average home are not likely to involve much actual computer processing.'*

Futurologists tell us that the major market for personal computers in the next ten years will be in the home. The other big markets will be small businesses and the professions (education, law, medicine). The hobbyist market will dwindle to insignificance and get lost in the mass home market. Before this dwindling into insignificance, let's look at the home market a little more critically.

I was discussing the topic of the home mass market with a personal computer manufacturer the other day. He metaphorically scratched his head and said 'Yes, but the unanswered question remains: what will house users do with a personal computer?' No-one has yet come up with any really credible answers.

Education is always a good answer if none other is readily forthcoming. PCs will be used to teach all those middle class kids their three Rs. But if you ask some of the big educational equipment manufacturers about the home market for educational products, they have been known (in private) to describe it as an oasis that never seems to get closer. PCs will of course be used to teach middle class kids programming — and that may be the major educational thrust of all.

If education is not the answer, then perhaps games playing is. There is undeniably a large market in the home for games (and the early experience with Prestel, the Post Office viewdata service, reinforces this). But general purpose personal computers are in competition with dedicated games playing machines. Just as in home education, they are in competition with dedicated teaching machines like Speak & Spell, the Little Professor etc. Dedicated machines are likely to be easier to use, hence more amenable to mass market requirements.

After education and games applications, the list becomes more problematic: budgets, VAT and income tax, dinner party recipes, family birthdays, control of other household gadgets. Indeed given the availability of cheap calculators, calculation type processing for things like household finance will not be needed on the personal computer. The average home has requirements for communication, storage and information retrieval rather than for lots of processing. Since the latter is likely to involve computer programming, it is even less likely to figure prominently in a mass domestic market. I believe it to be axiomatic in the next five years that, unlike the hobbyist, domestic users will not expect to have to be programmers (though their children may be). The domestic user, like the small business, wants computers to do things that are transparently useful with an English language dialogue facility.

Viewdata

If you are willing to accept the argument so far, then the mass domestic market's requirement for personal computers brings us close to viewdata. Viewdata has two particular characteristics that are relevant here: it doesn't require the user to know anything about computer programming; it is designed as a communication, storage and information retrieval system with little emphasis on the need for processing. Thus I believe it is reasonable to predict that as far as the mass domestic market is concerned, personal computers and viewdata systems will come together.

'Right now in the UK, there is only one public viewdata service capable of reaching into the home.'

To the layman, the computer is an empty machine. To fill it up, he has got to do something. If the computer is to be used for private data, then that private data has to be collected, sorted and entered. By analogy with television, it would be rather like having a tv set in the home with no external sources of broadcasting, or video cassette production. Viewdata brings to the empty personal computer external sources of information and entertainment and, via telesoftware development, even computer programs. This helps to fill the emptiness without a great deal of time and energy being expended by the user. Viewdata systems become, then, the computer

A Philips Viewdata Workshop in progress equivalent of broadcasting channels to the tv set. As with broadcasting, there is the parallel growth of software publishing via cassettes bought in the retail shop or via mail order. But this industry is still in its infancy (as is the videocassette videodisc publishing industry). Problems of compatibility and durability remain to be solved before a genuine paperback-type mass market can be expected to happen for personal computers. In the meanwhile, viewdata systems are in a key position to fill the gap!

Viewdata

age business user would spend £750 a year on Prestel — the figure [illegible] rental for a 16" colour set, telephone and Prestel charges for use. The average home user would spend £440 a year (this includes rental of a 22" colour set). Whereas for the business user the set rental would be £300 out of £750, for the home user the set rental

tive. As with tv broadcasting, new 'channels' are likely to emerge at competitive prices.

In the United States, the union of personal computers and viewdata type systems has also begun. Amid much publicity, *The Source* opened in June 1979 from the Telecomputing Corporation of America. The user requires a personal computer with telephone dial-up facilities. The service is only open out-of office hours. The price is low — $2.75 per hour of use. The user can get UPI news services, games,

An editing terminal from Philips Viewdata Systems

Right now in the UK, there is only one public viewdata service capable of reaching into the home. Its trademark is Prestel and it is owned and operated by the Post Office. The public service began for Londoners on 11 September 1979. Prestel computer centres have been planned to open in Birmingham, Manchester, Edinburgh from December 1979 onwards. By the end of 1980 well over 50% of the UK telephone population will be able to reach a Prestel computer via a local telephone call.

In the short term, there is one major constraint on the development of Prestel in the home market: cost. Bryan Quilter, managing director of Granada TV Rental Ltd, gave the following cost predictions at a recent Mills & Allen seminar: the set rental would be £400 out of a total of £434. As a result, in Quilter's view, the [illegible] was further away. He did [illegible] that the home user spend [illegible] £440 [illegible] broadcasting, teletext and Prestel — not just Prestel. ITT Consumer Products in September 1979 forecast a market for domestic viewdata sets of 100 000 in 1982 growing to 550 000 in 1985. In 1985 the penetration of viewdata would be 10% of homes. As the domestic market expands there are likely to be other viewdata systems for public access — the Post Office is not defending any monopoly here. Indeed, the Granada TV Prestel sets have four buttons for automatic dialling, only one of which (Prestel) is currently operational. [illegible] in Cobol, Basic and Fortran plus an electronic mail facility.

Communications capability is, in my view, essential to the development of personal computers as a mass domestic product. The great break through in Prestel is the arrival of the integral modem set. Down the paired wires of the telephone system, the empty machine will be filled and refilled. For the computer buff, programs can be quickly distributed. For the general home user, information and entertainment, plus contact with friends and relatives. Roll on 1985.

Richard Hooper is Managing Director of Mills and Allen Communications Limited

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WHO NEEDS CHEESE WHEN THE TRAP IS SO PRETTY?

Imagine yourself sitting at your desk busily working away at something or other definitely feeling in charge of your situation confident of your knowledge of your market the products you sell (or don't sell) or as in my case the words you write

Suddenly the phone rings Nothing new in that you might think the damn thing seems to ring all day You pick it up and say your jolly intro, and a voice comes on the line saying something that is not unadjacent to the following Ah good morning my name is Smith You don t know me but I was wondering if you could help me I want to buy one of these Pet thinggies

"Ah ha" you think a punter You turn on your smooth chat module in your brain and launch forth The first question if you re honest about doing business (at least it s my first question and you can take that anyway you like) has got to be what do you want to do with it

Our Mr Smith then launches into a whole string of half thought out business activities he would like to see run by his own his very own computer system He is an isurance broker in the City He deals with 75 different insurance companies and underwriters that on average offer 150 different types of policy — he thinks He doesn t know for sure because he s never actually counted them) Each of these policies has on average about a dozen different alternatives Again he doesn t know for sure He employs people who understand these things

Mr Smith wants to keep an active up to date record on every single one of these policies — you know the sort of thing he says blithely name and address of underwriter description of policy details of the various rates to be paid for what return to the insured and when what my commission is it goes on and on

What he wants is no mean database management system and no mean memory system to put it on

Viewpoint

But that is just the start for Mr Smith has customers as well as suppliers So the next question is how many? Oh thousands he says contentedly they come and go Some we see quite often do a lot of business you know others we only see once a year Some we see only once

Mr Smith wants a 'simple' little sales ledger to deal with that Then of course he wants all those boring little ledgers that accountants require you to keep as well He's not even sure how many there are he'd not really thought about it until you took the trouble to ask him

Now comes the crunch question how much have you got to spend?'

'Ah' comes the reply these Pet thingies cost about £600 don't they so let's say about £650 in total

I wonder how many bells this is ringing so far I have a feeling that it should be quite a few for I can't be the only person in the country getting one of these phone calls a week. What makes it depressing is that really no-one should get such calls at all

Before going further let me first state that the little story just outlined has nothing specifically to do with either Commodore or the Pet personal computer It just happens to be the name that most of the potential microcomputer users who have only a vague idea of what they want to do have latched onto What is far more important than the name is the idea that these people seem to have latched onto

'Ah, good morning, my name is Smith You don't know me but I was wondering if you could help me'

That is that one of these thingies (and believe me they do actually use that word) will do everything they need for £600 In specific instances they get upset when they are told that perhaps they ought to talk to IBM or Digital Equipment They're convinced that a computer can be bought for £600, they've read about it so why go to IBM where everyone knows they charge absolutely millions No matter that a £600 Pet or a £2000 Apple or a £3000 Cromemco or whatever is at best only part of the solution A computer is a box and the box can perform these tricks whether it costs £10 or £10 million

The many Mr Smiths seem to have little idea of what is involved in a computer SYSTEM let alone a computer and it is saddening that so many of them have so little idea of the *fundamental importance of software as an integral part of the system* A surprising number don't even seem to be too clear what software is

This points to two facts one of which is immediately obvious while the other is secondary but [illegible] in the long term

The obvious point is that the [illegible] ity of the potential [illegible] systems know [illegible] about the subject yet through [illegible] advertisements for low [illegible] think that perhaps they do [illegible] thing. They feel sure that by [illegible] it will automatically work It [illegible] that the great intangible software [illegible] value or importance is often beyond their comprehension The fact that it is probably going to cost them four five maybe ten times the value of the hardware just smacks of being a rip-off

So somewhere the microcomputer business is failing the user and that can only be a bad thing for by 1983 the industry is expected to be selling 250 000 systems a year in the UK The users won't be around if they can never understand what it is they are actually buying

This vast army of potential users need to be educated now into the basic points of computing of how much an installation is really going to cost that software is not a trivial irrelevance

Perhaps this is something that the recently formed Computer Retailers Association could consider especially as it grows bigger It could be the ideal vehicle for such a task for it should theoretically at least represent a consensus view of the industry and it would certainly be in the interests of its members to see that such education was available

To a large extent the fact that this education is needed implies no particular fault of the microcomputer business it is just a magnified function of the global misconceptions that exist about computers in general

There is however one area where the business and in particular the manufacturers of the hardware is at fault To some extent this fault lies in the roots to the business Microcomputer hardware is based upon the capabilities squeezed onto the archetypal sliver of silicon by the semiconductor manufacturers These guys however, by their own admission consider themselves to be in the jelly bean business — they make semiconductors by the pantechnicon load — and they don't really care that much what the user does with them Their main concentration has quite properly been on exploiting their expertise in a technology to make better products that would sell even more components

The systems designers have by and large grown up in that environment of technology exploitation and have used the capabilities presented to them to produce equipment that only a few years ago was just a dream But to some extent they have fallen into the same trap as the semiconductor manufacturers — they are not particularly bothered about what the user might want to do with the box

We have ended up with a situation that is largely based on a technology fetish We have some of the most amazing mouse traps in the world but not many people seem to have bothered about the cheese to actually make it all work

This brings me to the second point the one that is not so obvious but is probably much more important in the long run That is the state of software already available for the user

What I am not going to do is point any fingers at any individuals or companies in the micro software business but a general observation is well worth making

Most of the software that is currently available for microcomputer systems seems to have been written by enthusiastic computer freaks for other enthusiastic computer freaks What seems to have been forgotten is that 99 99% of the new users know NOTHING about software and more importantly shouldn't have to know anything The programs they use in practice should be idiot proof so that no matter what stupidity they perform in data entry or loading the system doesn't crash on them and they don't lose their data As a subsidiary point any application program should be flexible enough to fit their requirements exactly like a high fashion dress

'So somewhere the microcomputer business is failing the user'

But I hear voices say how can we produce programs like that at a cost the user will be willing to pay and make money at it? The answer probably lies in that nasty word investment The old saying of speculate to accumulate holds true here, as everywhere Enough investment in software development should be able to yield applications packages that are complex enough in themselves to be simple to use easily tailored to meet specific requirements and require no user knowledge of nasty words like Basic Fortran Cobol or Pascal

Yes I know such a program will need an investment of many thousands of pounds to develop But just think of the market potential for just one really good payroll program flexible enough to suit a wide variety of small business needs Imagine it with a retail price of around £100

Remember that UK market predictions indicate that in 1983 250,000 microcomputer systems of the small business type will be sold

Sell that program on a one for one basis and someone is sitting on a £25 million business

Martin Banks writes a weekly column Micro News for Computer Weekly on developments in the microcomputer industry

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DATABASE

In this series of [illegible] articles the [illegible] the organisation [illegible] ease of [illegible] access, extraction of exactly what the [illegible] in terms of relevant and useful information

Perhaps one of the most time-consuming tasks that many firms have to face nowadays is the storage and retrieval of information. It is not surprising then that many have chosen to computerise much of this process and to store the relevant data in a database using magnetic media.

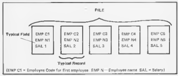

Fig 1

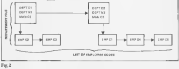

Fig. 2

What is a database?

The word has often been inadequately used to describe the storage and retrieval of a fairly simple set of entities, say a few fields in a sequential file. An example of such a file is:

Employee code, name & salary

Though in a sense one cannot maintain that such a file does not constitute a database, it will not cut much ice with managers. For any serious minded manager the storage and retrieval of the above information alone is not sufficient to help him evaluate situations and take decisions positively — he will soon want to know far more: he looks for information that enlightens.

To take an example from the engineering service industry, he will for instance want to know how much time each employee has worked on each of the projects currently handled by the firm. He will want to relate this information to a process whereby invoicing is handled automatically by the system, and the working man/days information is integrated with cash information, so leading to the automatic generation of trading, profit and loss accounts and the annual balance sheet.

If things were to stop there, there would be no further need for this article, as currently there are programs on the market which will do just that. But I do not only mean that, in addition to the above requirements, the manager will need to relate the information to stock recording (note that I do not speak of stock *control*, as the controlling aspect might involve some value judgements about which one should be clear in the context of a database) supplier and client information mailing lists, and so on An open ended list indeed

Nor did I mean that all this gathered information should not relate to modelling and evaluation techniques — which provide the proper framework for value judgements What I meant in addition, is the introduction of some further considerations forced on us through the concepts of time and change

The world around us is ever evolving employees leave, inflation roars on, laws are amended new types of energy are examined and of course, fashion changes

Typically, a service engineering firm will try to attract a new major contract by displaying to a potential customer the marvellous results obtainable through its sophisticated computer system And typically the potential client will voice new requirements to the despair of the data processing manager who has just completed the development and is perhaps hoping to rest on his laurels Too bad!

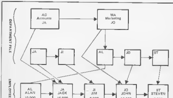

Fig 3

What are the options then?

A re-design of the computer system or the loss of business? Either way, it will be expensive

The alternative that some people have been putting forward for some time now and which is the subject matter of this series is that of a computer system flexible enough to cope rapidly with change and one also capable of handling all the aspects of a business Such a system, which by the way should be made as easy to use as possible, is often referred to as a management information or database system

I would like the reader at this stage to reflect that such a management information system is made up of two major components the actual stored information on the one hand, and the program (or process) which handles it on the other But that is not all

Database

As the majority of readers will be using small databases and micro-based systems I shall further be describing some of the desirable properties of such a management information system I shall not purport to be absolutely general or even unbiased, as my current thinking is much influenced by effecting such a set of management information programs on my own floppies based Pet microcomputer

File structures

For efficient storage and retrieval information requires structuring There are various levels at which structuring can be examined Two such are what I shall term the *logical* level and the *physical* level There are also other levels which I shall briefly mention later

The logical level is the user's view of the structure imposed on the data This is the one I intend to develop in some detail I shall begin with some definitions I shall call a database a set of files, perhaps interrelated but affording some degree of self sufficiency It's appropriate here to quote an illustrative example Referring back to the employee file quoted above this file is made up of three fields Employee Code, Name and Salary Assuming there are five employees in the firm, the information about employees may be presented as in Fig 1

As it stands, this EMPLOYEE file will be referred to as a *sequential* file, made up of *records*, one for each employee Assume now that information on Departments need to be stored There can be various Departments marketing accounts Against each Department, we might want to record

- The Department Code (DEPTC)
- The Department Name (DEPTN)
- The Manager Code (MANC) regarded as
- Employee Code
- The *list* of employees codes in this particular Department

In the list itself there would be no need to record information about employee names and salaries as such information is present in the EMPLOYEE file Moreover, a sequential file will not optimise storage and retrieval and the one illustrated below is referred to as a *hierarchical* file with two *levels*

The file of Fig 2 simply states that EMPC2, EMPC3 are in DEPTN1 and that EMPC1 EMPC5 and EMPC4 belong to DEPTN2

Note that MANC1 could be either of EMPC2 or EMPC3 Moreover, as against each employee code there is an employee description in the Employee File one uses *pointers*, some of which are shown as arrows in Fig 2 to relate the two files

Assume now a firm of five employees ALAN JACK JIM JOHN and STEVEN Their respective Codes are AL JA JI, JO and ST

Note that the codes are in the same alphabetic order as the names which is

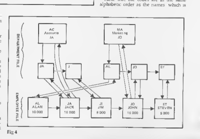

Fig 4

preferable. Assume that JACK is the manager for the ACCOUNTS department, and JOHN that of the MARKETING department. We can give these two Departments codes such as AC and MA respectively. The case where one employee may belong to more than one Department is possible but is not considered here.

The set of two files might look as in Fig 3.

Notice the additional pointers which relate the information in the two files. Diagrams like Fig 3 tend to become cumbersome rather quickly and moreover could have even further pointers in order to establish what is called an *inverted* structure in some kind of network as shown in Fig 4.

It now is possible, by examining the EMPLOYEE file first, then that of the DEPARTMENTS (ie in a kind of inverted order) to find the Department to which JOHN belongs in this instance he is in fact also the manager of that Department.

What are the famous pointers mentioned above?

To fully appreciate their meaning we should examine the *physical* level of data storage, rather than the logical level as we have been doing. Briefly at the physical level a pointer is a location which stores the address where the information is actually stored. This address does not refer to the memory of the computer but is that where the information is kept in backing store usually discs floppy discs for a small system.

The reader will immediately see that pointers do require storage space. It is even possible that the space they use might exceed the space available for actual information! However pointers are useful for the efficient retrieval of information. But their drawback is that they require maintenance — diligent updating — for them to be always effective. If STEVEN leaves the MARKETING Department for the ACCOUNTS Department the relevant pointer must be adjusted.

> *'For efficient storage and retrieval, information requires structuring.'*

A recent school of thought, based on the *relational* database approach, advocates doing away with pointers altogether and instead making the effort of relating the information from one file to another by *matching* codes each time the file is needed. There is a lot to be said for this approach and between the two extremes of a fully inverted database and a relational one there is a whole range of intermediate choices. I shall not join in the debate, except to say that individual systems ought to be examined in accordance with their individual needs and objectives. For myself, in the case of a general database management system, I am interested in only using those pointers needed to maintain a hierarchical structure within a system which allows a relational database structuring and retrieval should the end-user prefer this.

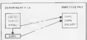

Fig 5

Now referring back to the logical level again another way of describing the relations in the data may be through their *file description*. This is made clear in Fig 5 which also indicates that the DEPARTMENTS File has two levels, whereas the EMPLOYEE File has only one level.

I might here mention that an interesting example of network structure arises when considering family precedence relations. I shall leave it to the reader to define a structure demonstrating parentship, brotherhood and ancestry relations in say a very small closed society.

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IMPACT OF MICROS ON HIGHER EDUCATION

The speed with which the microprocessor has appeared on the scene has been so high that the education system is in many ways lagging to cope. The most immediate problem lies in the training of established electrical and electronic engineers already in industry. In this article, however, we will consider its impact on Universities and Polytechnics.

Microprocessors and Microcomputers

The microprocessor is a component. It must be treated in perspective along with other integrated circuit (LSI) components. Understanding a microprocessor is tied to understanding how to build a computing *system* incorporating one, and to an overall knowledge of both hardware and software.

On the other hand, a microcomputer is a ready-packaged product. It provides a high-level software interface and, as such, is largely a sophisticated programmable calculating machine. Thus it is a tool for the teaching of software practice but more generally, it is a problem solving device.

Undergraduate Teaching

There are three major areas:

- Physical electronics
- Electronic engineering and computer architecture
- Computer science or software techniques

> *'The computer industry has long criticized the Universities for turning out either Electronics Engineers or Computer Mathematicians while the industry needs far more people with a broader hardware/software knowledge of computer systems.'*

Physical Electronics has previously been the domain of either Physics or Electronic Engineering departments, and I see no reason for this to change. The microprocessor has produced no specific new problems; this is a natural continuation of the progress of integrated circuit technology and is reasonably well catered for.

There are strong arguments about Britain furthering the LSI component manufacture versus buying foreign components. If the NEB's (National Enterprise Board's) INMOS venture is successful, there may be a need to increase the teaching of physical electronics — but I doubt it. There is a strong argument that one or two more Institutions should have some form of production facility to keep education abreast of practice.

Computer technology is already taught in most Electrical and Electronic Engineering departments. Their involvement, however, is not high enough to meet the new demands. It is vital to realise that the teaching of microprocessors per se is *not* a valid subject. The microprocessor is a *packaging* of the CPU of a computer. The teaching must centre around the fundamentals of computer architecture, with the microprocessor used as an example. Binary concepts, addressing, decoding, instruction registers, accumulators etc. — *these* are the topics of fundamental importance.

'Microprocessor' courses in undergraduate studies are clear examples of teachers jumping on bandwagons.

Microprocessor/computer architecture courses should obviously be integrated with electronics and logic courses. There should also be some attention paid to interfacing and peripherals.

Computer software techniques are normally taught by offshoots of Maths departments specialising in Computer Science. Engineering departments have organised teaching of high level language programming, eg. ALGOL, FORTRAN or BASIC, as problem solving techniques, not as computer education. Again, there should be little special teaching of microprocessor software techniques. The basic topics of data structures, compilers, operating systems, etc. are applicable to any class of computer. It would be useful if current microprocessors could be used in practical examples of, say, Assembly

Language programming, but this is much more related to what equipment is available for hands-on practice.

The Problems

The problems created in this environment specifically by microprocessors are:

- Volume. Most students of electronics now need a training in computers, not just computer programming.
- Integration. The computer industry has long criticized the Universities for turning out either Electronics Engineers or Computer Mathematicians while the industry needs far more people with a broader hardware/software knowledge of computer systems. The few highly dedicated computer courses like Manchester's can cope within a single department. Others need to combine the resources of the Electronics and Computer Science departments as we have done in Cardiff. This is not easy, since it requires not only inter-departmental but also inter-faculty co-operation — achieved at Cardiff with a lot of good will on both sides.

Specifically with microprocessors, however, it becomes necessary to incorporate specialist software courses into the traditional Electronic courses. Thus Computer Science departments must be asked to provide special courses in parallel with courses currently run in mathematics, say. In Cardiff we teach a short course in system software overview and a full-time course in machine code programming. We have used an existing course on PDP-11 code through expediency but hope to lay on a new specialised course in 8080 programming. This can cause some friction since the Engineering department loses teaching hours to the Computer departments, but they are the software experts, and can provide the programming practicals and tutorials.

'Thus, by and large, teachers are often only one step aheed of students'

I must stress here that there is a big difference between new Computer-biased courses and expanding the computer orientated content of Electronics Engineering Courses.

Steff

There are always changes in emphasis in Undergraduate degree courses, notably the drift from heavy Electrical Engineering towards Electronics. The rate of change is normally slow enough for members of staff to change their own fields and for retiring members to be replaced by specialists in the newer technologies.

In injecting a near step-function change in emphasis, the microprocessor has created distinct problems to which there can be no easy solution.

Frankly, those of us in the Engineering field already specialising in Micros are hardly experienced — nobody is! Thus, by and large, teachers are often only one step ahead of students. Indeed, with the very enthusiastic hobbyist clubs now around, the students could be ahead. The danger here is of bowing to enthusiasm and failing to teach sound fundamentals and good engineering practice. How many teachers of engineering now moving into micros have experience of structured programming or fully understand the importance of standards and documentation? I am afraid that now the blind lead the blind, and will do for some years to come.

Much of the Government's expenditure on education in the microprocessor field must be directed towards educating the educators.

Laboratory Equipment

The current situation with laboratories is little short of disastrous.

Again, this is largely due to the rate of change in requirements. Most labs start with no micro equipment. Simply to lay on a new range of lab experiments requires dozens of simple microcomputer evaluation boards. These *must* also be supported by some experience of a proper microprocessor development system (MDS). The chronic danger is of young engineers being exposed to micros only at the evaluation board level, and entering industry unaware of the need for an MDS.

For reasons of cost effective debugging, documentation standards and flexibility an MDS (or equivalent time-shared facilities) is an industrial *necessity* not a luxury. I am afraid many teachers, let alone students, do not fully appreciate this point. Thus enthusiasts set up simple experiments at £150 a head, say, whereas a more realistic figure to re-equip a lab to stay on par should be around £500 per bench plus, say, £15 000 for MDS facilities.

There are also requirements to introduce students to other tools such as Logic Analysers. Thus, at a conservative estimate each Electrical Engineering lab in the country needs an immediate injection of around £20 000 just to start the ball rolling. This assumes that the normal influx of money continues as well to maintain stocks of power supplies, oscilloscopes etc. Space may be a problem but in general these new experiments replace rather than expand, older ones.

There will, however, be a growing use of departmental microcomputers rather than expanded use of centralised computing resources and these will require space. Typical of this type of equipment will be multi-terminal machines running simple Editors and Assemblers dedicated to teaching.

Postgraduate end Research Work

With all the current interest in Microprocessors there should be no shortage of graduates interested in continuing to study for higher degrees.

Over the last few years, however, because of financial problems there has been a dramatic fall in quality British students continuing their studies.

The Science Research Council (SRC) grants available to graduates with 1st and upper 2nd class honours degrees amount to less than £1 500 per annum. This contrasts badly with the £3.000 + salaries offered by industry. This gap will get significantly bigger. There is now a dramatic increase in the demand for electronics graduates, a result of drastic stupidity in the British system which has, over the years, pushed its best brains into non-productive professions, notably medicine, law and accountancy. The new appeal of electronics as a career, and the increase in status and salaries that the current supply and demand situation will create, will not solve our national problem since there is a five year lag in the supply system.

'The current situation with laboratories is a little short of disastrous'

Finance for research students, however, is not the only problem in this field. Despite being of such great interest, microprocessors do not lend themselves to academic *research* topics: essentially they generate high class *applications* projects somewhat at cross-purposes with the accepted rules of academic research standards. The problem is more serious that it may seem at first sight since, in the current situation, the U.K. must develop products to stay in world markets, and University expertise and facilities can play a major role. There is a grave danger of misdirecting facilities merely to keep in line with traditional practices, whereas some new scope is needed for the next four or five years.

In this climate, research fellowships are probably the best way in which Universities can actively partake in *and* contribute to, product development. Free of the constraint of having to submit a Ph.D thesis, projects with more 'D' than 'R' are quite viable. A properly organised Institution can run supervised R & D (Research and Development) projects employing good class people for around £10,000 p.a. (Plus any special hardware) compared to around £20,000 p.a. for industry.

The big problem here is under-costing (you only get monkeys if you pay peanuts) and the relatively short duration of most projects.

In practice, one must offer a Research Fellow at least 3 years tenancy. Thus we must bend a little to take on multiple one-year contracts, with the colleges themselves possibly guaranteeing continuity in the rare case of a continuation project failing to materialise immediately. If we are able to offer £5 - 7 000 salaries, we can then attract the right people. Note that I do not exclude such researchers from submitting for higher degrees but this is very much a secondary feature.

While industry is the obvious source of such Research Fellowships the SRC also has some funds for similar ventures. Here, however, the "purity" of the research projects still dominates and stifles much of the more 'applicable' concepts. The SRC's problem in assessing requests for grants is severe, and I am afraid that there is much dissatisfaction with the situation amongst University and Polytechnic research supervisors. It is difficult to see how to lessen the problem, but I hope that, for the next few years they will give more support to application orientated projects.

Most laboratory equipment for research work is acquired through specific grants which accumulate over the years. My figure of £10 000 p.a. per head includes £2,000 or so for the lab equipment "kitty". However, the step-change with microprocessors has made the accumulation rate too slow. Each and every department in the country with more than, say, three actively involved researchers, could do with a no strings attached grant for development systems of say £10,000. Preferably a deal could be done with a vendor for bulk purchase reductions or a U.K. system selected and enhanced for the purpose. The important thing is to avoid the awful deterrent of making soul-destroying applications to the SRC, just to take a place in the lottery.

Currently with insufficient equipment, there is a big clash for resources between students and researchers, particularly around Easter time as undergraduate projects come to a head.

A further problem with microprocessor research is that there is a big involvement of engineers new to computing. How many engineers have even heard of structured programming? How many text books exist to teach good programming and system design practice biased towards engineering applications? Thus many of the research projects which interest engineers are considered old-hat by Computer Scientists. Who will work on Real-time executives for micros? To the specialist software scientist it is merely reinventing the wheel, following the path well served in mini computers. And yet Intel's RMX 80 is the only well known product on the market!

This problem isn't new, for example the economists were doing research projects on control theory at a level taught to second year undergraduates in electrical engineering.

Non-Computer Specialists

With the availability of cheap microcomputers like the PET (note, not microprocessors) many University research workers in all fields have become computer users. Our Geology department, for instance, makes excellent use of a Computer Workshop microcomputer for capturing data and performing simple local processing. This in fact is probably much more effective than the use of central computing services. However there are problems. First, it is not as easy to interface instruments with computers as appears at first sight. Almost certainly specialised electronics work will be required which the electronic engineering teaching departments are not organised (nor should be) to service; this means a bigger requirement for a pool of electronic technicians and leads to my second point, which is that the (naive) users will get fobbed off with totally inadequate equipment. Both the servicing, interfacing and advisory services are tied to the expanding role of the computer centres — or they should be!

The new microcomputers are of major importance in Business applications.

'Currently, with insufficient equipment, there is a big clash for resources between students and researchers.'

General Computing Facilities

With older computing equipment economies of scale quite naturally led to each College establishing a centralised mainframe computing facility. This also created a control pool of expertise providing advisory services to all users. In many cases the facilities have been enhanced to link machines into networks, largely so that specific features can be concentrated at one site and still be made available to a wide range of users. Originally computing centres were attached to Computer Science departments, but in most cases now the functions of service and teaching are quite separate.

With microcomputers there is already a split with many users purchasing their own small machines for personal use. Thus departmental funds are being spent in addition to central government funding. Uncontrolled expansion of this nature will cause serious repercussions in maintenance and program advisory services — and also a lot of repetitive program development.

The Universities Computing Committee have recently conducted a study and have made recommendations as to how the centres can expand the service and advisory roles and steadily reduce the central hardware facilities. In my opinion they have erred on the cautious side, possibly underestimating the variety of program development facilities available on microcomputers. Certainly the new generation of 16-bit micros, with 1 MByte address space will be powerful batch processors. I can envisage one time-shared mainframe being replaced by four or five simple single-stream computers, each with large memories. Further, these machines can be physically distributed so that users can get at the machine, and floppy discs will be sufficient.

At present, large disc stores are required to keep programs and data available. With floppy discs the user can keep his own data.

I can further envisage special machines, with multiple terminals, dedicated to interactive program entry, editing and creating floppy discs (or communicating direct with other machines in a local network).

Thus I see mainframe computers being on the whole replaced by multiple single-stream computers. A much reduced, but nationally inter-connected network of specialised large machines will be retained for high computing load requirements even though I envisage very large programs being run on microcomputers. I do, however, see the role of the computer centres expanding rather than contracting, since a centre of expertise and a mechanism for controlling and distributing standard programs must be maintained.

Conclusion

In general, the impact of microprocessors on higher education is both stimulating and frightening. There is a definite need of cash injections to improve laboratory facilities. We could also do with some money to take advantage of the new office products. With all the report and letter writing that goes on, word processing facilities would be most welcome.

Earlier in this article I mentioned the problems faced by existing staff, and also the financial problem of attracting research students. Possibly in the near future we are also going to face the problem of attracting new staff. The salaries offered to lecturers in Universities and, to a lesser extent, Polytechnics are most uncompetitive with Industry. There is a grave danger that new staff appointed over the next few years will be below standard. Once in they are there for life: not an encouraging thought to end on.

Dr Martin Healey is one of Britain's foremost authorities on microprocessors and their applications. He is at University College Cardiff.

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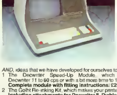

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